

RAMC
COLL

/GRE

✓
A.M.D. 2.



22501311997

Digitized by the Internet Archive
in 2016 with funding from
Wellcome Library

<https://archive.org/details/b28711385>

FORTY-THIRD ANNUAL REPORT

OF

THE LOCAL GOVERNMENT BOARD,

1913-14.

SUPPLEMENT

CONTAINING THE

REPORT OF THE MEDICAL OFFICER

For 1913-14.

Presented to both Houses of Parliament by Command of His Majesty.



LONDON :
PRINTED UNDER THE AUTHORITY OF HIS MAJESTY'S
STATIONERY OFFICE

By DARLING AND SON, LTD., BACON STREET, E.

To be purchased, either directly or through any Bookseller, from
WYMAN AND SONS, LIMITED, 29, BREAMS BUILDINGS, FETTER LANE, E.C.,
28, ABINGDON STREET, S.W., and 54, ST. MARY STREET, CARDIFF; or
H.M. STATIONERY OFFICE (SCOTTISH BRANCH),
23, FORTH STREET, EDINBURGH; or
E. PONSONBY, LIMITED, 116, GRAFTON STREET, DUBLIN;
or from the Agencies in the British Colonies and Dependencies,
the United States of America, the Continent of Europe and Abroad of
T. FISHER UNWIN, LONDON, W.C.

1914.

[Cd. 7612.] Price 1s. 11d.

CONTENTS.

MEDICAL OFFICER'S REPORT :

	PAGE
SECTION I.—SOURCES OF INFORMATION	vi
PATHOLOGICAL FACILITIES FOR THE DIAGNOSIS OF DISEASE	vii
SECTION II.—INTERNATIONAL HYGIENE	x
FOREIGN INTELLIGENCE WORK	x
MEASURES TAKEN TO PREVENT THE IMPORTATION OF DISEASE	xi
PLAGUE RATS	xii
INTERNATIONAL SERVICE BY THE MEDICAL DEPARTMENT	xiv
SECTION III.—INFANT AND CHILD MORTALITY	xv
STATISTICAL STATEMENTS	xvi
SCHEMES FOR MATERNITY AND CHILD WELFARE WORK ...	xix
HISTORY OF CHILD WELFARE WORK	xxii
CHILD WELFARE WORK IN URBAN CENTRES	xxiv
" " " " ADMINISTRATIVE COUNTIES	xxv
DEAD BIRTHS	xxvii
REDUCTION IN BIRTH-RATE	xxviii
EXTENT OF PRESENT ANTE-NATAL PUBLIC HEALTH WORK	xxx
ANTE-NATAL WORK AT METROPOLITAN HOSPITALS ...	xxxi
THE ORGANISATION OF MATERNITY CENTRES	xxxii
MORTALITY IN CONNECTION WITH MATERNITY	xxxiii
SECTION IV.—THE ACUTE INFECTIOUS DISEASES	xxxv
NOTIFICATIONS OF INFECTIOUS DISEASES	xxxv
SCARLET FEVER	xxxvii
DIPHTHERIA	xxxix
TYPHUS FEVER	xliii
ENTERIC FEVER	xlv
SHELL-FISH AND ENTERIC FEVER	xlvii
MEASLES	xlix
WHOOPIING-COUGH	li
SMALL-POX	lii
CEREBRO-SPINAL FEVER	liii
POLIOMYELITIS	liii
SECTION V.—TUBERCULOSIS	lvii
A. <i>Administrative Control</i> —	
MILK	lvii
PUBLIC HEALTH ACTION FOLLOWING NOTIFICATION	lviii
VISITS AFTER NOTIFICATION	lix
EXAMINATION OF SPUTUM	lx
SIGNIFICANCE OF TUBERCLE BACILLI IN SPUTUM	lxi
INFECTIVITY OF PULMONARY TUBERCULOSIS ...	lxii
SCHEMES FOR THE TREATMENT OF TUBERCULOSIS	lxiii
TUBERCULOSIS OFFICERS	lxiv
TUBERCULOSIS DISPENSARIES	lxv
LONDON DISPENSARY SCHEMES	lxvii

SECTION V.—*cont.*

PAGE.

A. *Administrative Control—cont.*

CO-ORDINATION OF DISPENSARY WORK WITH THAT OF THE LOCAL SANITARY AUTHORITIES	...	...	...	lxxviii
OBSERVATION BEDS	...	...	...	lxx
THE IMPORTANCE OF EARLY DIAGNOSIS	...	...	...	lxxi
“FOLLOWING UP”	...	...	...	lxxii
EXAMINATION OF CONTACTS	...	...	...	lxxiii
TREATMENT AT DISPENSARIES	...	...	...	lxxiv
NEED FOR PROGRESSIVE DEVELOPMENT OF WORK	...	...	...	lxxv
DOMICILIARY TREATMENT	...	...	...	lxxvi
DENTAL TREATMENT	...	...	...	lxxvi
CARE AND AFTER-CARE	...	...	...	lxxvi
RESIDENTIAL INSTITUTIONS	...	...	...	lxxviii
ISOLATION HOSPITALS	...	...	...	lxxx
SMALL POX HOSPITALS	...	...	...	lxxxii
GENERAL AND SPECIAL HOSPITALS	...	...	...	lxxxii
SANATORIA AND COMBINED INSTITUTIONS	...	...	...	lxxxiv
CONSTRUCTION OF SANATORIA	...	...	...	lxxxv
HOSPITAL PROVISION FOR TUBERCULOSIS	...	...	...	lxxxviii
HOUSING IN RELATION TO THE HOSPITAL TREATMENT OF DISEASE	...	...	...	xc

B. *Statistics of Tuberculosis—*

SEX AND AGE DISTRIBUTION OF DEATH-RATE	...	...	xcii
REDUCTION OF DEATH-RATE ACCORDING TO AGE AND SEX	...	...	xciv
LOCAL DISTRIBUTION OF DEATH-RATES	...	...	xcv
NOTIFICATION STATISTICS	...	...	xcix

SECTION VI.—*VENEREAL DISEASES*

CONTROL OF SYPHILIS	...	...	ci
CONTROL OF OPHTHALMIA NEONATORUM	...	...	cv

SECTION VII.—*MISCELLANEOUS WORK OF MEDICAL DEPARTMENT*

LOCAL INVESTIGATIONS BY MEDICAL INSPECTORS	...	...	cvii
WORK IN CONNECTION WITH BYE-LAWS, &c.	...	...	cviii
PLUMBO-SOLVENT WATER SUPPLIES	...	...	cx
WORK OF INSPECTORS OF FOODS	...	...	cx
WORK IN THE BOARD'S PATHOLOGICAL LABORATORY	...	...	cxi
WORK IN THE GOVERNMENT LYMPH ESTABLISHMENT	...	...	cxi
VACCINATION AND PUBLIC VACCINATION	...	...	cxii
CHANGES OF STAFF	...	...	cxiv

SECTION VIII.—*AUXILIARY SCIENTIFIC INVESTIGATIONS*

CAUSES OF ARTERIAL DEGENERATION	...	...	cxv
SEROLOGICAL DIAGNOSIS OF SCARLET FEVER	...	...	cxvi
CAUSATION OF ACUTE PAROTITIS	...	...	cxvi
EFFECT OF OPEN-AIR AND WIND ON RESPIRATORY METABOLISM	...	...	cxvii
CHARACTER AND SOURCE OF TUBERCULOUS INFECTION IN CHILDREN	...	...	cxviii
POISONOUS PROPERTIES OF FERRO-ALLOYS, &c.	...	...	cxvii

APPENDIX A :

No. 1.—Vaccinal Condition of Cases of Small-pox occurring during 1913	1
No. 2.—Summary by Dr. Reece of Information as to Cases of Poliomyelitis and Cerebro-Spinal Fever notified during 1913	2
No. 3.—Abstract of a Report by Dr. Fletcher on an outbreak of Scarlet Fever attributed to Milk in the Rural District of Woodbridge in 1913	6
No. 4.—Report by Dr. Manby on an outbreak of Enteric Fever in the Urban District of Kenilworth	11
No. 5.—Report by Dr. Macewen on an outbreak of Diphtheria in South London attributable to Milk Infection	30
No. 6.—Report by Dr. Macewen on an outbreak of Small-pox in Milnrow, in its relation to infection in a Cotton Mill	43
No. 7.—Report by Dr. Seymour on the occurrence of Lead Poisoning in the Urban District of Guisborough, and its relation to the Public Water Supply	47
No. 8.—Extract from a Report by Dr. Chapman on the use of "Observation" Beds... ..	68
No. 9.—Memorandum by Dr. Lane-Clayton on Health Visiting	72
No. 10.—Summary of the Work of Inspectors in the Medical Department during 1913-14... ..	76
No. 11.—Abstract of Medical Inspections made in 1913-14 with regard to the Incidence of Disease on Particular Places, and to Questions Concerning Local Sanitary Administration	83
No. 12.—Report by Dr. MacFadden on the Work of Inspectors of Foods during 1913-14	104
No. 13.—Report by Dr. Blaxall on the Operations of the Government Lymph Establishment, 1913-14	116
No. 14.—Report by Dr. Eastwood on the Work of the Board's Pathological Laboratory, 1913-14	118
No. 15.—Digest of the Vaccination Officers' Returns with regard to Children whose Births were Registered in the year 1912	119
No. 16.—Circulars, Memoranda, and Orders issued by the Local Government Board in 1913-14, relating to Questions affecting the Public Health	126
No. 17.—Tuberculosis Statistics... ..	143

APPENDIX B :

No. 1.—Report by Dr. Andrewes on Arterial Degeneration... ..	151
No. 2.—Report by Dr. Rajchman on an Investigation into the possibilities of Serological Diagnosis of Scarlet Fever	209
No. 3.—Further notes by Dr. Blaxall on the advantages of preserving Glycerinated Calf Lymph in Cold Storage at a temperature below the Freezing Point	220
No. 4.—Second Report by Dr. Blaxall on the use of Oil of Cloves in the preparation of Glycerinated Calf Lymph... ..	227
No. 5.—Report by Dr. Blaxall on some experiments to test the value of Ether as an Agent for the Purification of Vaccine Lymph	232

REPORT.

TO THE RIGHT HONOURABLE HERBERT SAMUEL,
M.P., PRESIDENT OF THE LOCAL GOVERNMENT
BOARD.

Sir,

I HAVE the honour to submit the following report, which describes some of the outstanding features characterising the public health in England and Wales during the year 1913, and reviews, for the year ending March 31st, 1914, the work carried out under the general direction of your medical officer.

It is convenient to place on record a summary of the state of the public health during the year 1913, so far as it can be summarised in terms of reduction of death-rates from all causes and from special diseases. Comparing the experience of 1913 with the average experience of 1891-1900, the rate of infant mortality has declined 29 per cent., the death-rate from measles 32 per cent., from scarlet fever 64 per cent., from whooping-cough 62 per cent., from diphtheria and croup 55 per cent., from enteric fever 77 per cent., from tuberculosis (all forms) 33 per cent., and from pulmonary tuberculosis 28 per cent., from puerperal diseases 27 per cent., from pneumonia 17 per cent., and from bronchitis 41 per cent.

The death-rate from all causes has declined 25 per cent. between 1891-1900 and 1913.

In each of the sections of the report which follow, administrative considerations arising out of the work of the last year are set out in conjunction with a statement of the course of events as indicated by our national statistics of sickness and mortality.

The records of disease and the measures required for the prevention of disease naturally divide themselves into two parts, according as they are concerned with disease imported from abroad, or with disease which is endemic in this country and which in some instances may become epidemic apart from importation from abroad. The first section of the report is concerned with our sources of information, for without information as to the facts of life and death (births, sickness, deaths) preventive measures may be haphazard in character. This information is derived in part from national and in part from international sources; and in the second section of the report certain considerations as to international hygiene receive attention. Then follows a review of the history of the chief acute infectious diseases during the year. In subsequent sections the prevention and treatment of tuberculosis and of venereal diseases are considered. In view of the rapid development of maternity and child welfare work by local authorities, this subject, as also tuberculosis, is discussed in somewhat full detail. In the last section of the report the different branches of the work of the Medical Department of the Board are passed under review, including the scientific investigations undertaken on behalf of the Board.

SECTION I.

SOURCES OF INFORMATION.

Public health work is dependent to a very considerable extent on information as to the incidence of sickness and mortality. The facts of disease have always formed a most urgent incentive to sanitary reform; and much of the earliest sanitary work of the 19th century in this country was due to repeated invasions of cholera, and to the discovery that this disease prevailed particularly under grossly insanitary circumstances.

The establishment of the General Register Office in 1837 and the periodical publication of statistics of deaths and causes of death in different areas have been an important factor in leading to investigation of disease and to diminution in its amount.

In my last annual report I summarised (p. viii) the important reforms introduced by the Registrar-General in making the national statistics of mortality more widely useful in the service of preventive medicine. Special reference was made to the measures taken to secure more accurate local statistics, by means of arrangements as to "transferable deaths" as defined in the footnote on page viii. of my last year's report, and in the notes to Table I. issued by the Board to medical officers of health for their guidance in the preparation of annual reports. Such transferable deaths number about 40,000 a year; and the transferences are made with the help of medical officers of health. The Registrar-General in the preface to his report to 1912 refers to the success of the arrangements made for securing accurate local vital statistics, and expresses his "thanks to the medical officers of health throughout the country, and especially to county medical officers of health for their valuable assistance in securing accurate transferences of deaths from the district of occurrence to that of residence."

It is unnecessary to state in detail the stages by which the notification of various forms of sickness has been brought into action to aid registration of deaths, as a means of increasing our knowledge of disease and of measures for its prevention. The history of notification of infectious diseases was sketched in my prefatory remarks to the first annual issue of "Statistics of the Incidence of Notifiable Diseases in each Sanitary District in England and Wales," dealing with the statistics of the year 1911 (N.S. 64), to which reference may be made. The Board since the beginning of 1911 have distributed to every medical officer of health a weekly statement giving the number of cases of each infectious disease which have occurred during the previous week in every sanitary area, followed at the end of the year by an annual summary of the incidence of each infectious disease in every sanitary area. Every medical officer of health is thus furnished with information as to threatenings of disease, and the Medical Department of the Board are enabled to keep systematic watch on areas in which excess of a particular disease manifests itself, with a view to local inquiry as required. Three years' statistics of annual incidence of notifiable infectious diseases, excepting tuberculosis, in every sanitary area have been prepared in the Medical Department of the Board, and we

have now available important and complete information, the value of which increases steadily year by year. Since January, 1909, the Board have distributed weekly information to medical officers of health of port and riparian districts as to certain forms of sickness occurring in foreign ports.

A fuller statement follows as to more recently adopted means for increasing our knowledge of disease.

Pathological Facilities for the Diagnosis of Disease.

A most important means of increasing knowledge of the nature of illness and its exact incidence, and of increasing the success of treatment consists in the use of modern pathological facilities for these purposes.

In a memorandum prepared for the Departmental Committee on Tuberculosis, which was re-published on pp. 214-233 of my last annual report, I set out information as to the facilities for the pathological diagnosis of disease provided by county councils and county borough councils, and stated the main reasons for attaching great public health importance to such provision. In summarising the principles of action which appeared to need to be followed in future extensions of public health pathological work, the opinion was expressed that "in order that a satisfactory medical service may be secured throughout the country, facilities for work similar to that now being done in hospitals will need to be offered to medical practitioners generally."

Early in the present year I obtained a detailed return from the medical officer of health of every county, county borough, metropolitan borough, and all other urban districts with a population over 20,000 as to the laboratory work in the diagnosis of disease carried out in each of these areas during the year 1913.

The details of this work are set out in the following table:—

Official Arrangements for Pathological Work by Local Authorities, 1913.

Character of Specimen.	Number of Specimens examined by				
	Administrative Counties.	County Boroughs.	Metropolitan Boroughs.	Other Urban Districts with a population over 20,000.	Total.
1. Serum for Widal reaction ...	2,078	4,304	420	791	7,593
2. (a) Serum for Wassermann reaction	—	201	—	4	205
(b) Examination for spirochaetes	30	12	—	—	42
3. Blood for malaria ...	4	22	—	—	26
4. Other blood examinations ...	116	360	48	45	569
5. Bacteriological examination of blood, &c., in puerperal fever.	4	165	—	5	174
6. Cerebro-spinal fluid for determination of infecting organism and for enumeration of cells.	44	143	12	93	292

Character of Specimen.	Number of Specimens examined by				
	Administrative Counties.	County Boroughs.	Metropolitan Boroughs.	Other Urban Districts with a population over 20,000.	Total.
7. Swabs for diphtheria ...	39,495	70,271	11,271	31,433	152,470
8. Examination for tubercle bacilli—					
(a) of sputum ...	13,325	35,716	9,142	5,000	63,183
(b) of milk ...	1,528	3,992	68	445	6,033
(c) of urine ...	108	312	1	191	612
9. Examination of milk for—					
(a) micro-organisms other than tubercle bacilli.	40	619	49	66	774
(b) dirt... ..	136	1,524	64	120	1,844
10. Material in connection with food poisoning.	259	51	—	23	333
11. Pus, &c., for gonococci ...	64	197	38	36	334
12. Hair, &c., for ringworm, favus, &c.	9,539	5,498	10	2,463	17,510
13. Examination for pathological organisms of—					
(a) faeces ...	28	446	4	11	489
(b) urine ...	143	533	—	10	686
14. Vomit or faeces for occult blood...	2	104	1	1	108
15. Pleuritic and ascitic fluids ...	31	89	—	3	123
16. Morbid tissues for malignant disease, &c.	29	121	—	8	158
17. Other materials ...	51	88	44	47	230
18. Microscopical and chemical examination of urine.	284	769	5	8,423	9,481
19. Chemical examination of calculi, &c.	—	1	—	1	2
20. Chemical examination of test meals.	—	9	—	—	9
21. Any other examinations ...	820	20,372	18	198	21,408
Total ...	68,158	145,919	21,195	49,416	284,688

The total number of specimens examined on behalf of different classes of authorities during 1913 was as follows:—

—	Number.	Number of specimens.	Number of Authorities under each head providing facilities and examining specimens over 12 in number.
Administrative Counties ...	62	68,158	43
County Boroughs ...	80	145,919	73
Metropolitan Boroughs... ..	29	21,195	27 (No return from 2)
Other Urban Districts with a population over 20,000.	160	49,416	83
Total ...	331	284,688	231

It is useful to note also, as in the following table, the number of specimens examined in each of these classes of authorities under certain special headings, in proportion to the population concerned.

Number of specimens examined per 1,000 of population.

	Serum for Widal reaction.	Swabs for diphtheria.	Examination for tubercle bacilli.	All others.	Total.
Administrative Counties (excluding London, but including towns over 20,000 population).	0·14	3·44	1·00	1·13	5·71
County Boroughs	0·36	5·96	3·39	2·66	12·37
London	0·09	2·49	2·04	0·07	4·69
Total	0·21	4·13	1·89	1·48	7·71

The extent to which pathological work now being carried out by these authorities is undertaken in their own municipal or county or hospital laboratories, and to what extent in other laboratories working for local authorities, will be seen in the following table:—

Number of specimens examined for local authorities in different classes of laboratories during 1913.

Laboratories at which the examinations were carried out.	Administrative Counties.	County Boroughs.	Metropolitan Boroughs.	Other Urban Dis- tricts with a popula- tion over 20,000.	Total.
Council's Laboratories... ..	50,633	111,373	5,736	36,450	204,192
(a) Pathological	50,633	36,343	5,736	21,471	114,183
(b) Isolation Hospital	—	75,030	—	14,979	90,009
University Laboratories	12,341	27,949	—	6,540	46,830
Lister Institute... ..	288	2,851	4,077	823	8,039
Clinical Research Association... ..	1,031	66	5,479	1,738	8,314
General Hospital Laboratories	387	308	2,356	214	3,265
Other Laboratories	3,478	3,372	3,547	3,651	14,048
Total	68,158	145,919	21,195	49,416	284,688

The expenditure on these laboratories during 1913 is stated to have been over £23,000 or £1 per 1,600 population. This statement is probably incomplete. In Manchester the amount spent was £1 per 337, in Sheffield £1 per 339 of population. In some areas there has been little or no development of this work; the towns mentioned above have developed it very extensively.

The recent Budget proposals, providing for a large extension of pathological facilities, render it hopeful that such facilities will ere long be available for any disease in which these facilities are helpful for prevention, diagnosis, or treatment.

The proposals now under consideration will be more fully considered in next year's report.

SECTION II.

INTERNATIONAL HYGIENE.

From the commencement, after the passing of the Public Health Act, 1858, of the work of the Medical Department at the Privy Council, preventive measures against imported disease formed a large part of its activities, and the success of our modern measures against exotic disease is shown by the fact that since 1866 cholera, although not infrequently introduced, has failed to gain a footing in this country. This result is in large measure owing to the rapid improvement in the sanitation of the country, but is also largely attributable to work following on International Sanitary Conferences and Conventions and to the admirable work done by our chief port sanitary authorities and their officers.

Foreign Intelligence Work.—In recent years the increased volume of shipborne commerce between this country and foreign countries, together with the accelerated voyages due to the modern steamship, has brought this country into continuously closer relationship with foreign countries. Owing to these conditions it has become more necessary to obtain complete intelligence of the outbreaks of infectious diseases in foreign countries, so as to keep in touch with their progress in order to prevent their entry at our ports.

Our information is derived chiefly from the telegrams and despatches with which we are supplied by the Foreign Office through their diplomatic and consular services in foreign countries. The Colonial Office also furnish us with information as to what is going on in the Crown Colonies. In addition, a large number of foreign journals, some weekly, some fortnightly, some monthly, and many annual, are noted in the Medical Department day by day, as they come in, both in regard to the statistics of disease in the countries they come from and to information given by them as to the occurrence of epidemic disease in other foreign countries. The daily press of this country, including the "Shipping and Mercantile Gazette," frequently supplies early and useful information. The Government of India furnishes statistical reports weekly and fortnightly practically of the whole of the Indian Empire. Bulletins are prepared in the Medical Department and sent out weekly to the medical officers of health of our port and riparian districts to inform them as to ports infected with plague, cholera, and yellow fever. The source of our information, and the number of cases and deaths

and the date of their occurrence are given if available. Only the above-named exotic diseases are dealt with by the International Convention; but the Medical Department of the Board also keep records of typhus fever, small-pox, cerebro-spinal meningitis, poliomyelitis, pellagra, and some other infectious diseases which occur mainly abroad, together with notes of the latest epidemiological and research work published about them. These last-named diseases are not included in the weekly bulletin, owing to the difficulty of obtaining early information of their occurrence, and in view of their widespread endemicity; but it is intended to notify our ports of any large or virulent outbreaks of these diseases when they occur in foreign ports. The work here indicated dates back from the years when it was undertaken at the Privy Council. It has been continuously carried out, but in recent years its scope has much increased. Fortunately, opportunities for obtaining early information have also increased owing to the greater accuracy and promptitude of the despatches received through other Departments of His Majesty's Government, and the improvement in the official weekly bulletins which many countries now publish. The International Health Office has proved a source from which it has been possible to obtain much information that was otherwise unavailable, both through their monthly bulletin and by direct correspondence. Reports are regularly received from the International Board of Health of Constantinople, from the International Quarantine Board of Egypt, and with less regularity from the International Board of Tangiers. Official weekly sanitary bulletins are furnished by Austria, Germany, the Public Health Service of the United States, by Switzerland, Egypt, British India, and Ireland. Besides these weekly bulletins we receive from six countries monthly official reports, and from four countries quarterly reports. Numerous reports are received from municipalities. About twenty English and foreign journals are read and noted in the Medical Department for the information of the Board, in relation to research work on infectious diseases and general epidemiological work undertaken in different countries.

Yearly account of Prevalence of Exotic Diseases.

An account of the prevalence of cholera, plague, and yellow fever in different countries of the world has hitherto been included in the medical officer's annual report. Owing to delay in obtaining information as to foreign disease, the publication of this account has on one occasion been delayed for a year. This year also it has been found impossible to complete the account of foreign disease in time to secure its insertion in the present report, and it is proposed to issue it as a separate report.

Measures taken to prevent the Importation of Infectious Diseases.

The first line of defence against these diseases consists in the measures administered by the port sanitary authorities under

the Board's Order of September 9th, 1907. This deals only with cholera, plague, and yellow fever, and is drawn up in conformity with the provisions of the International Sanitary Convention of 1903. In addition, port sanitary authorities can make regulations under Section 125 of the Public Health Act, 1875, which, with the consent of the Board, give them power to deal with persons infected with dangerous infectious disorders. The port and riparian medical officers of health are kept informed by the Board as to the exotic diseases existing in foreign ports, and the officers of His Majesty's Customs, in conjunction with the masters or pilots under the International Convention, stop all ships which are infected or suspected and those on which a dangerous infectious disorder has occurred, to await medical inspection by the port medical officer. Hospitals are provided at the ports by the port sanitary authorities for the isolation and treatment of dangerous infectious diseases arriving on ships. Questions are asked as to the occurrence of unusual mortality amongst rats in ships coming from plague-infected ports and, if necessary, the ship is fumigated for their destruction. In this respect the Board have had under consideration the possible modification of the existing Port Orders which may be needed on the ratification of the International Convention of 1912. This Convention recommends periodical deratisation of empty ships, at least every six months. A conference on this subject was held at the Board with the medical officers of health of our chief ports. The measures taken with regard to infected and suspected ships in British ports are calculated to interfere as little as possible with commerce or inter-communication with foreign countries. Observation as understood by the International Conventions is rarely resorted to in our ports except for actual contacts, surveillance being almost always substituted for it. With surveillance, names and addresses of passengers and crew are taken and news of their arrival is sent to the medical officer of health of the district to which they are going, and by this means if they fall ill after their arrival they can be isolated at once. Substantially, we have for a long time past depended more and more upon our internal sanitary organisation than upon the first line of defence to prevent the spread of imported disease from foreign countries. Emigration and immigration are superintended by an official medical inspector of aliens, who is often also port medical officer of health, in all ports where there is much traffic of this kind. In this way a good many diseased persons are prevented from gaining access to this country.

Plague rats.—If plague in rats is allowed to spread in ports or towns it is exceedingly costly and difficult to get rid of and so long as it exists amongst the rats there is danger that sooner or later human beings will be infected. It is true that in Great Britain bubonic plague has never in recent years spread in epidemic form from rat plague, but isolated cases and groups of cases of human infection by rats have occurred at long intervals. Probably this limitation is due to the fact that in this country very few people live in close contact with rats, and the opportunity for flea infection from the rat is rare compared with that

in warmer climates in which the houses are less solidly built and more easily penetrated by the rat.

The extermination of rats is a hopeless task if the measures adopted consist solely in destruction by virus, poisons, and traps. Rats must be deprived also of access to their usual food if any considerable reduction is to be obtained in their number. Houses found infested must be made rat-proof, and offal and house refuse disposed of in covered receptacles inaccessible to rats. In ports it is of great importance that, besides catching or destroying rats, all warehouses intended for the storage of grain or foodstuff should be thoroughly rat-proof. After some correspondence which arose out of the fact that on several occasions plague-infected rats were found in parts of the Port of London during 1913,* the Board sent Dr. Spencer Low to inspect the warehouses of the Port of London Authority† especially those which were used for the storage of grain and foods. His report, to which further reference will be found elsewhere, showed that many of the food and grain warehouses were rat-infested. To discuss this question a conference took place on September 26th, 1913, between the Board's officers, and officers of the Port of London Authority, and of the Port Sanitary Authority of London. It was intimated to the Port of London Authority that conditions existing in their dock warehouses used for grain and food storage attracted rats, and favoured their multiplication, and that plague-infected rats were occasionally found in the docks (13 infected rats were found in the year 1912 and 7 in 1913). The damage done to merchandise and buildings by rats was made the subject of discussion. It was pointed out that human cases of plague might occur either through personal contact with the fleas of plague-infected rats imported into the docks, or through a general epizootic of plague in London's rats, started by infected rats from abroad. The loss to the commerce of London, should its port be declared to be infected with plague, was represented. The advisability of ensuring that all new warehouses intended for storage of food stuffs and grain should be built rat-proof, and that old ones should be rat-proofed as the opportunity occurred, was urged upon the representatives of the Port of London Authority.

The Port of London Authority at present are spending large sums on building new docks. They store in their docks and warehouses only a small part of the grain and foodstuffs (20 per cent. of grain and 25 per cent. of foodstuffs) which are brought into London, and their representatives urged that reform in the directions indicated as necessary should be begun in the wharves along the banks of the Thames. The Port Authority were prepared to undertake certain immediate improvements. Corre-

* No plague-infected rats have been found there during 1914 up to the month of August, though thousands are caught and those presenting suspicious appearance are examined.

† This is the Dock Authority, and must not be confused with the Port of London Sanitary Authority

spondence on the subject is still open between the Board and the Port of London Authority at the time of writing.

The expense of making new food warehouses and grain stores rat-proof and attending to the faults of the existing warehouses would be small in comparison with the losses that would accrue to London ship owners and to London commerce should the port be declared at any time infected with plague.

In this connection the following remarks by Dr. Williams, the medical officer of health to the Port Sanitary Authority of London, in his last annual report, may be quoted. After commenting on the severe measures taken during the plague epidemic in San Francisco with regard to the export of foodstuffs, he says: "Should plague break out in London, and if foreign countries should decide to inflict similar restrictions on all foodstuffs leaving the Port of London, under the conditions existing at the present time, such exports would be practically prohibited."

International Service by the Medical Department.

Upon the retirement of Dr. Theodore Thomson, C.M.G., through ill-health, Dr. R. W. Johnstone was appointed British Representative on the Permanent Committee of the International Health Office. He attended the April and October meetings of the Committee in 1913. At the April meeting it was announced that Chili, the Principality of Monaco, and Denmark had adhered to the diplomatic arrangement of December 9, 1907. These accessions raised the number of countries taking part in the International Health Office to 30. Reference was made to a mission which had been sent to Constantinople to advise the Ottoman sanitary administration with regard to the prevention of cholera, which had been epidemic some time in Turkey. A report by Dr. Garcia Izcara, of the Hygienic Institute Alphonse XIII., upon the relation between bovine and human tuberculosis was read and discussed. A report upon the work of the Cholera Committee was read by Dr. Pottevin, the General Secretary, which contained also some observations upon researches made by himself with regard to toxines.

The question of a mission to be sent to study cholera in India was discussed as well as the competency of the International Health Office under its statutes to send out missions of research. The discussion was postponed to the following meeting for a further report from the Cholera Sub-Committee. The efficiency and administrative success of compulsory notification of tuberculosis, in countries which had adopted it, was discussed, and further discussion was postponed to the next meeting.

Amongst other subjects dealt with were the dangers of cold-stored meat, the sterilization of drinking-water and a report by Dr. Pottevin on the Ozone process at St. Petersburg, and a further account of a similar process at Saint Maur for purifying the water of the River Marne for the use of Paris. A communication from Dr. Chicote, Director of the Municipal Laboratory of Madrid, was read by Dr. Pulido, the subject being a

vaccine and anti-serum for enteric fever. The rôle of flies in the transmission of infectious diseases was debated.

At the October meeting the question of syphilis and its prevention was introduced by Dr. Ruysch, and a sub-Committee, of which Dr. Johnstone was a member, was appointed to study the question further and to edit a questionnaire for submission to the Committee at a later sitting. The Committee then considered whether the conclusions that can be drawn from past experience, especially of the practice of anti-typhoid vaccination, would enable a systematic attack to be organised against enteric fever. At the next sitting the administrative measures which are taken for the prevention and suppression of bovine tuberculosis in different countries were discussed, and in this connection Dr. Madsen of Copenhagen read an interesting paper on the conditions existing in his country. Dr. Pottevin gave an account of some researches he had carried out. In the course of his experiments he had discovered a method of infecting small monkeys with cholera by putting them in a condition susceptible to the disease by the administration of a purgative of 7 or 8 grains of sulphate of soda, before giving the requisite dose of culture of cholera vibrio. The method was confirmed at the Lister Institute by Dr. C. J. Martin. Further discussions were undertaken on flies and their dangers, and how to deal with them. A paper on non-biting flies and disease, by M.M. Breton and Bruyant of the Lille Pasteur Institut, was read by Dr. Calmette, and discussed.

SECTION III.

INFANT AND CHILD MORTALITY.

In previous annual reports, and in special reports,* the subject of infant and child mortality has been studied in various aspects. For many of the points which would otherwise be stated here, and for statistics as to infant and child mortality in different months of life and from various causes, reference should, therefore, be made to these reports.

It is satisfactory to note that, although it was higher in 1913 than in 1912, the general trend of the curve of infantile mortality continues satisfactory.

* Report by the Medical Officer of the Local Government Board on Mortality during the First Five Years of Life, dealing with the Statistics of Sanitary Areas (grouped) and of Administrative Counties of England and Wales. [Cd. 5263.]

Report by the Medical Officer of the Local Government Board on Mortality during the First Five Years of Life, dealing with the Statistics of 212 Towns and 29 Metropolitan Boroughs during the Four Years 1907-10 (grouped) and in 1911. [Cd. 6909.]

Reports by the Medical Officer of the Local Government Board and by Drs. Copeman, Manby, Farrar, and Lane-Claypon on Infant Mortality in Lancashire, with special reference to seven towns within the county. [Cd. 7511.]

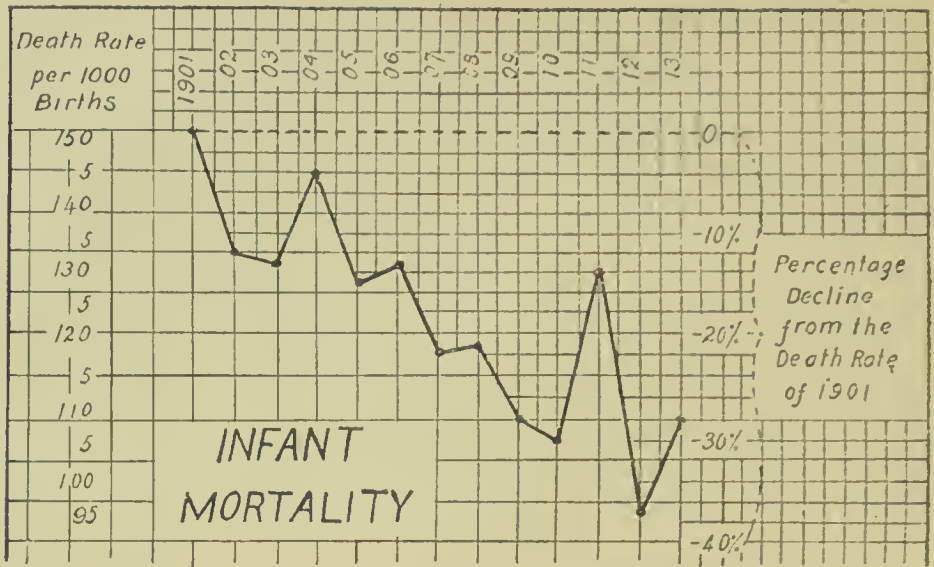


FIG. 1.

England and Wales.—Rate of Infant Mortality per 1,000 Births, 1901–13.

At all ages under 5, as shown in Fig. 2, the decline in the death-rate was equally satisfactory.

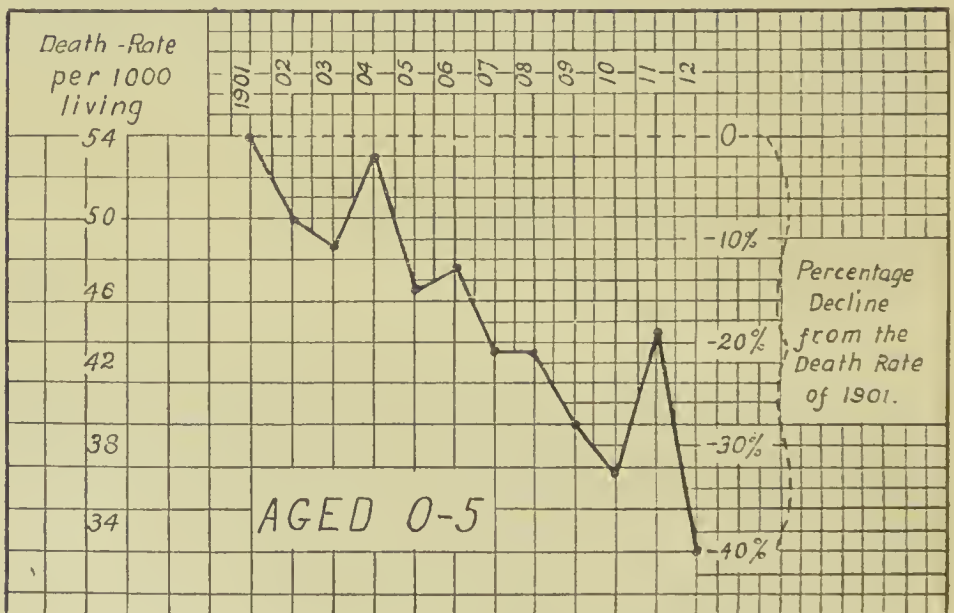


FIG. 2.

England and Wales.—Death-rate per 1,000 living at ages 0-5, 1901–12.

The attention of medical officers of health may be drawn to the valuable study of some aspects of infant mortality in Dr. Stevenson's contribution to the annual report of the Registrar-General of Births, &c., in England and Wales for 1912. In one part of this study he deals with the mortality in different parts of the country up to the age of 5 years. In the following table, extracted from this report and based on the experience of the year 1911, is shown the survivorship up to the end of the fifth year of life out of a given number born in various divisions of the country.

	Survivors at each age out of 100 children born.		
	At end of 1st year.	At end of 2nd year.	At end of 5th year.
London	91	88	85
County Boroughs	89	86	82
Other Urban Districts	91	88	86
Rural Districts	92	90	89

The largest number out of a given number born survive to the end of the fifth year of life in rural districts, the smallest number in county boroughs as a whole.

Dividing these results for county boroughs into the divisions of the country concerned—north, midland, south, and Wales—it is found that in the southern division 88 out of every 100 born survive at the end of the 5th year of life, 83 surviving in the midlands, and only 81 in the north of England and in Wales.

The statement in the footnote of the relative magnitude of different causes of mortality in infancy and in the first five years of life, taken together, throws light on the possibilities of saving of child life.*

* *Deaths in England and Wales, 1912, at Ages under 1 and under 5, from Various Causes.*

	0—1 year.		0—5 years.	
	Deaths.	Per-centage of Total Deaths.	Deaths.	Per-centage of Total Deaths.
Measles	2,533	3·1	11,812	9·3
Scarlet fever	76	0·1	1,110	0·9
Whooping-cough	3,989	4·8	8,159	6·4
Diarrhoea and enteritis	6,734	8·1	8,493	6·7
Tuberculosis (all forms)	2,459	3·0	7,137	5·6
Venereal diseases	1,204	1·5	1,286	1·0
Other infective diseases	614	0·7	3,266	2·6
Bronchitis and pneumonia	15,623	18·9	27,265	21·5
Meningitis	1,120	1·4	2,462	1·9
Disease of eyes	5	0·0	12	0·0
" " ears	149	0·2	348	0·3
" " mouth	180	0·2	238	0·2
Heart diseases	37	0·0	195	0·2
Rickets	301	0·4	728	0·6
Cancer and other tumours	23	0·0	120	0·1
Scurvy	15	0·0	21	0·0
Other general diseases	166	0·2	345	0·3
Infantile convulsions	7,413	9·0	8,740	6·9
Premature birth, atelectasis, and injury at birth.	19,521	23·6	19,521	15·4
Atrophy, debility, and marasmus	10,281	12·4	10,281	8·1
All other causes	10,336	12·4	15,535	12·0
Total	82,779	100·0	127,974	100·0

It will be seen that over 21 per cent. of the total deaths in infancy and nearly 33 per cent. of the total deaths in the first five years of life are due to various infective diseases, among which in the order of magnitude for all ages under 5 are measles, diarrhœa and enteritis, whooping-cough, and tuberculosis. It is significant also that, under the present conditions of certification of death, which tend to prevent practitioners from entering the full facts on death certificates, one per cent. of the total deaths under five is returned as due to venereal diseases. Bronchitis and pneumonia, although not included in the above group, may also be regarded as infective diseases; they account for nearly 19 per cent. of the deaths under 1 and nearly 22 per cent. of the deaths under 5 years of age.

The most important remaining causes of death are premature birth, atelectasis, and injury at birth, causing 23·6 per cent. of the total infantile deaths. These are entirely due to causes operating at or before the birth of the infant. A less definite group, "atrophy, debility and marasmus" causes 12·4 per cent. of the total deaths of infancy. It is uncertain to what extent the deaths in this group are due to congenital causes and to what extent to lack of adequate care at and soon after birth. A large proportion is due to ante-natal infection and especially to syphilis.

The problem of saving child life and securing the correlative improvement in standard of health of survivors to higher ages, evidently consists very largely in the prevention of infections, including diarrhœal diseases and acute respiratory diseases. The prevention of measles and whooping cough is discussed on page xlix. The prevention of diarrhœa is in part concerned with the improvement of sanitary environment, within and around the home, in part with the cleanliness of food, in respect of its storage, preparation, and suitability for the infant. In all these diseases the influence of the previous nutrition of the infant has great importance, and rickets is very commonly the factor in a child's condition which determines the fatal result of any infection by which it is attacked.

The amount of syphilis shown in the death returns represents only a fraction of the total disease caused by it. It is a common cause of still-birth and of premature birth; and a considerable proportion of the deaths from marasmus and atrophy, as well as a large amount of disease in childhood and during school life, owe their origin to it.

The returns of causes of death in early infancy are unsatisfactory, but it may be assumed that most of the deaths under one month of age are due to causes operating at or before birth. Deaths at this early age have been separately stated in the Registrar-General's reports since 1905, and their share in the total death-rate under one year of age is given below.* Com-

* *England and Wales.—Infant Death-rates per 1,000 Births in the year.*

—	1905.	1906.	1907.	1908.	1909.	1910.	1911.	1912.
At ages under 1 month	41·8	41·9	40·7	40·3	39·7	38·5	40·7	38·4
.. 1-3 months ...	24·8	25·7	23·3	24·2	20·4	20·0	24·8	17·6
.. 3-6	24·8	27·0	21·3	23·6	19·2	18·8	26·1	14·8
.. 6-12	36·8	37·9	32·3	32·4	29·4	28·2	38·5	24·0

paring the experience of 1912 with that of 1905, it will be seen that in the first month of life the death-rate fell 8 per cent., in the next two months of life 29 per cent., in the second three months of life 40 per cent., and in the second half of infancy 35 per cent. The greater reduction secured in the later months of infancy has been very largely in respect of diarrhoeal diseases and diseases of the respiratory organs. The relatively small decrease of mortality in the first month of life is owing to the fact that congenital disease and enfeeblement are largely responsible for the deaths in this period.

In order that this relative lack of success in early infancy may not continue, revised and extended work is needed. The lines on which this is contemplated and recommended by the Local Government Board are set out in the scheme below. No natural line of distinction can be drawn between the different branches of child welfare work. The results of evil conditions arising during pregnancy or during early infancy are seen in disease developing to its full extent after childhood. It is important, therefore, that administrative action in respect of child welfare should be so arranged as to have regard to all the factors concerned.

A statement of the more important lines along which action is needed is set out below. This scheme was sent to each county council and sanitary authority on the 30th July of this year along with the circular letter which follows, and it is inserted here as much of the matter in it is concerned with work which has engaged a large part of the time of your medical officer during the last year.

*Circular.
County Councils
and
Sanitary Authorities.*

LOCAL GOVERNMENT BOARD,
Whitehall, S.W.,
30th July, 1914.

MATERNITY AND CHILD WELFARE.

SIR,

I am directed by the Local Government Board to state that an estimate has been laid before Parliament for a grant to be distributed by the Board in aid of the expenditure of local authorities and voluntary agencies in respect of institutions or other provision for maternity and child welfare.

This grant, if voted by Parliament, will be made in aid of expenditure in respect of clinics, dispensaries or other institutions primarily concerned with the provision of medical and surgical advice and treatment, as well as in respect of the salaries of health visitors and other officers engaged for this work.

The Local Government Board have in recent years devoted considerable attention to questions connected with infant welfare and they have observed with much satisfaction that efforts have been made by many local authorities and voluntary agencies, to deal with the matter. These efforts

have undoubtedly helped to secure improved conditions for children and have played an important part in the campaign for the reduction of infantile mortality.

It is evident from the Reports issued by the Medical Department of the Board and those of many Medical Officers of Health that more extended and systematic measures than have hitherto been generally adopted are necessary, and it is hoped that the grant of assistance from the Exchequer will stimulate those local authorities who have not yet taken action to give the matter their earnest consideration and will encourage those already engaged in work to develop it still further.

Up to the present local authorities, in their infant welfare work, have concerned themselves more especially with the child in its first year of life; the matter is, however, one which needs to be dealt with on a more comprehensive basis and it is clearly desirable that there should be continuity in dealing with the whole period from before birth until the time when the child is entered upon a school register, *i.e.*, the register of a public elementary school, nursery school, crèche, day nursery, school for mothers, or other school.

Extension of the existing work is accordingly needed in two directions; on the one hand it is necessary that measures should be taken for securing improved ante-natal and natal conditions, and on the other, provision should be made for continuing the work in relation to children beyond the first year of life.

The accompanying memorandum, which has been prepared by the Board's Medical Officer with a view to assisting the formulation of schemes or extending the work already undertaken, sets forth in outline the matters needing consideration in the preparation of a comprehensive scheme. It will be seen that the memorandum contemplates that medical advice and, where necessary, treatment should be continuously and systematically available for expectant mothers and for children till they are entered on a school register, and that arrangements should be made for home visitation throughout this period.

The work of home visitation is one to which the Board attach very great importance, and in promoting schemes on the lines laid down in the accompanying statement the first step should be the appointment of an adequate staff of Health Visitors.

It will be desirable, at all events in the case of the larger urban authorities, to provide consultation centres which may fitly be termed Maternity Centres, to which expectant mothers and mothers with infants and little children may be referred for advice and treatment; the operation of these Maternity Centres will be rendered most effective if co-operation is secured with the midwives of the district and with any local hospital having a maternity department.

It will be necessary to arrange for a medical officer to be in charge of such a Centre and for the attendance at the Centre of members of the staff engaged in home visiting. Careful records, for which the medical officer should be responsible, will need to be kept, and in regard to children the records should be in such a form that they may subsequently be available for the information of the School Medical Officer when the child is entered at a school.

For the rural and smaller urban areas the Board think it will generally be found desirable to develop a county organisation, but in all cases the county work should be intimately related with that of the local sanitary authority, and on the other hand any work separately undertaken by a sanitary authority should be co-ordinated with the county scheme.

It is not expected that all local authorities will be able at once to initiate complete schemes, but it is important that any partial arrangements that may be made shall be such as can ultimately form part of a more extended organisation.

Subject to the estimate now before Parliament being accepted by Parliament, the Board will be willing to consider applications for grants in respect of any work falling within the scope of the scheme outlined in the memorandum accompanying this letter; the grants will normally amount

to one-half the approved expenditure on any of these purposes, but may be less if the Board so decide.

Grants to institutions of the nature of Schools for Mothers, the object of which is primarily educational, which provide training and instruction for mothers in the care and management of infants and little children, and which may include systematic classes, or home visiting, or infant consultations (the provision of specific medical and surgical advice and treatment, if any, being only incidental), will be administered by the Board of Education. Any cases of doubt or difficulty will be investigated by a Joint Committee of Officers of the two Boards, which will include women Medical Officers.

In sending a copy of this circular to voluntary agencies engaged in infant welfare work, the Board will state that applications for grants in respect of voluntary work may be made by a voluntary agency either directly or through a local authority.

The grant now presented to Parliament will be appropriated in aid of the expenditure of the half-year ended 30th September, 1914, and applications for grants should be accompanied by an account of the work undertaken by the authority, and by a detailed statement of the expenditure incurred, certified by the officer of the local authority in charge of the accounts.

I am to add that the Board will be happy to afford advice and assistance to local authorities in the initiation of schemes or the extension of existing schemes.

I am, Sir,

Your obedient servant,

H. C. MONRO,

Secretary.

The Clerk to the Council.

MATERNITY AND CHILD WELFARE.

A complete scheme would comprise the following elements, each of which will, in this connection, be organised in its direct bearing on infantile health.

1. Arrangements for the local supervision of Midwives.

2. Arrangements for—

ANTE-NATAL.	{	<p>(1) An ante-natal clinic for expectant mothers.</p> <p>(2) The home visiting of expectant mothers.</p> <p>(3) A maternity hospital or beds at a hospital, in which complicated cases of pregnancy can receive treatment.</p>
-------------	---	---

3. Arrangements for—

NATAL.	{	<p>(1) Such assistance as may be needed to ensure the mother having skilled and prompt attendance during confinement at home.</p> <p>(2) The confinement of sick women, including women having contracted pelvis or suffering from any other condition involving danger to the mother or infant, at a hospital.</p>
--------	---	---

4. Arrangements for—

- POST-NATAL. {
- (1) The treatment in a hospital of complications arising after parturition, whether in the mother or in the infant.
 - (2) The provision of systematic advice and treatment for infants at a baby clinic or infant dispensary.
 - (3) The continuance of these clinics and dispensaries, so as to be available for children up to the age when they are entered on a school register, *i.e.*, the register of a public elementary school, nursery school, crèche, day nursery, school for mothers or other school.
 - (4) The systematic home visitation of infants and of children not on a school register as above defined.

LOCAL GOVERNMENT BOARD,
Whitehall, S.W.

July, 1914.

History of Child Welfare Work.—The movement for the saving of child life is not a very recent development, though public interest in it has greatly increased during the last few years. The possibility of saving of child life depends primarily on increase in medical knowledge of children's diseases and of their causation: and increase in the clinical and pathological knowledge of children's diseases, as well as disease generally, has, therefore, had an important share in bringing about the improvement already secured. During the last quarter of a century medical officers of health, especially in our large urban centres, have endeavoured to apply this medical knowledge in public health administration, especially in regard to diseases like rickets and diarrhœa, which belong to a large class of diseases due in part to dietetic errors and in part to insanitary environment. During this period the public, chiefly by means of reports of medical officers of health, of the Registrar-General, and of officers of this Board, have steadily and to a rapidly increasing extent been educated to a sense of the importance of the subject and to a knowledge of means for the prevention of disease, and have been induced to adopt many reforms conducive to child welfare. For a long series of years the annual reports of medical officers of health have reviewed the infantile mortality of each sanitary district. Many of these reports, doubtless, have been perfunctory. To others we are indebted for a large portion of our knowledge of the subject. Nearly the whole literature of the public health aspects of infant mortality has been written in annual and special reports of medical officers of health.

A further impetus to this concentrated attention on infant mortality was given by the Local Government Board requiring medical officers of health to set out a detailed statement for each month of the first year of life of the number of deaths from each

of 27 specified causes. The memorandum, issued in 1905, of the medical officer of the Board on annual reports of medical officers of health, contained the following remarks:—

It is well known that in many parts of this country the infantile death-rate remains unduly high; that it differs widely in districts the circumstances of which are not definitely dissimilar; and that within the limits of a given sanitary area this death-rate may exhibit striking diversities. Not a few Medical Officers of Health, in their annual reports—more particularly in reports for recent years—have dealt in detail with this subject, thus making important contributions to better understanding of conditions which conduce to infant mortality. Nevertheless, statistics available in this connexion do not afford, except in a broad and general way, satisfactory bases for comparison of district with district, nor, indeed, always for useful contrast of different sections of the same district.

A table of the sort now prepared permits record in regard of each sanitary district as a whole (as also in respect to each of particular sub-divisions of his district which the Medical Officer of Health may select for comparison) of certain facts as to infant mortality in each of the several weeks of the first month of life and in subsequent months; facts which, when accumulated for a series of years, may prove of definite value in instituting comparisons such as have been referred to. In the text of his annual report, the Medical Officer of Health will, no doubt, comment on the facts that he has recorded in his table or tables, offering, at the same time, observations on the conditions which, in his view, have mainly contributed to any special infant mortalities witnessed, and giving account of any measures adopted to ameliorate those conditions regarded by him as specially hostile to infant life. In so far as modification of procedure for the purpose, or of law in facilitating such modification is, in his opinion necessary, the Medical Officer of Health is invited to state his views.

It is not proposed that report on the above lines be limited to districts exhibiting unduly high infantile death-rates. Data are desirable respecting districts low in the scale of infant mortality, with comment by the Medical Officer of Health on the facts that he is recording, and indication of the conditions which, in his view, have principally conduced in his district to comparatively insignificant infantile death-rate.

and Sir William Power on p. xxiv. of his annual report for 1905-6 made the following additional comment:—

It is also anticipated that by employment of this or similar method for record of facts for a series of years, Medical Officers of Health, in the matter of infant mortality in their districts, will obtain trustworthy basis for comparison of ward with ward or of sub-area with sub-area, and will, at the same time, be establishing data which later on may prove of high value for making analogous comparison of town with town.

The comparative infant mortality figures contained in my second report on infant and child mortality were based on the information derived from these tables.

Among early work for infant life preservation may be mentioned the subsidisation more than 20 years ago by the Manchester Sanitary Committee of the work of the Ladies' Health Society, which employed a large staff of sanitary or health visitors.

It is scarcely necessary to summarise the work done prior to 1906, but it may be mentioned that as early as 1899 Salford commenced a system of voluntary notification of births by midwives. The action of the town of Huddersfield in 1906 in obtaining powers to secure the compulsory notification of births within 36 hours of birth represented a rapid growth of

opinion based on experience in that and other towns, to the effect that in the absence of early information of birth the necessary sanitary precautions and counsel as to personal hygiene could not be given with the greatest prospect of success. This local pioneer work doubtless facilitated the passing of the Notification of Births Act in the year 1907.

At the middle of June, 1914, this Act had been adopted or put into operation in each metropolitan borough; in 75 out of 80 county boroughs, representing 97·0 per cent. of their total population; in 104 out of 243 other boroughs, representing 67·0 per cent. of their population; and for 35·7 per cent. of the rest of the population of England and Wales.

Corresponding to the rapid extension of the Notification of Births Act, the number of health visitors employed by local authorities has rapidly increased. Over 600 health visitors, commonly employed solely in the work of visiting infants, are paid by sanitary authorities and county councils, in addition to the much larger number of voluntary workers acting more or less in co-operation with them. This implies that for the whole population of England and Wales there is, in addition to voluntary workers, a health visitor for about every 6,000 children under compulsory school age, or more than one health visitor to every 4,000 children under this age in areas in which the Notification of Births Act has been adopted, a number which, though less than is needed, shows that this work is already well established.

There is much general evidence that the home visiting and collateral work which has followed the adoption of the Notification of Births Act has resulted in a large saving of child life. Although too much stress should not be laid on the comparison of statistics of infant mortality in districts which have adopted this Act with statistics for the same period for other districts, attention may be drawn to the evidence given by Dr. Eustace Hill in his annual report for the County of Durham for 1912 of the greater decline in infant mortality in districts in the first group. The case for child welfare work cannot be based, however, on statistics, in which it is difficult to compare homogeneous populations, under conditions which are equal, apart from notification of births. It is reasonable to act on the assumption that the hygienic advice secured by the visits following notification must have valuable influence in securing improved health in childhood.

Child Welfare Work in Urban Centres.—The character and extent of development of this work varies greatly in different centres. It is unnecessary to set it out here in detail, as fairly full particulars were given in the Second Report on "Infant and Child Mortality" [Cd. 6909]. A more recent description of this work in the County of Lancashire is given on pp. 137 to 197 of the recent special report on "Infant Mortality in Lancashire" [Cd. 7511].

The work when well organised may be illustrated from the local activities of the municipalities of Birmingham, Liverpool, Manchester, Bradford, and Sheffield, and of the voluntary societies working in co-operation with them.

The extent of this work may be gathered from the number of official health visitors employed by them. In Birmingham these at a recent date numbered 37, in Liverpool 26, in Manchester about 30, in Sheffield 18. In Manchester and Liverpool the infant consultations and similar organisations are under voluntary management. In Liverpool home visiting is done in connection with the work at the municipal milk depôt, as well as independently of this. In Sheffield there is a municipal infant consultation on five days a week, the town council paying the physicians in charge £250 per annum. In Birmingham there are five municipal infant consultations, in addition to a number of similar voluntary agencies. A woman assistant medical officer of health conducts these consultations. In Bradford there is a municipal infant consultation and milk depôt employing three whole-time women medical officers and 13 nurses. A new central infant welfare centre is being built, estimated to cost £14,000, which will include 20 beds for the in-patient treatment of non-infectious cases of children under school age.

Child Welfare Work in Administrative Counties.—This work is not yet so fully developed as in many of the county boroughs. The organisation of county work under the Notification of Births Act, although in the first instance somewhat experimental, has proved successful; and much experience has now accumulated as to the best methods for carrying it out. The work already done has shown that work among infants and young children is much needed in the rural and smaller urban areas. Although the total infant mortality rate is lower than in towns, there is frequently a large mortality from prematurity, debility, atrophy and marasmus, and the mortality from other causes varies greatly in different social strata, even in favourably situated areas. Furthermore, in some of the smaller urban areas and even in certain so-called rural areas, the conditions of life approximate to those of the poorest ward in a town.

Many municipal boroughs and large urban areas have already adopted the Notification of Births Act independently of the county council, and have for some years carried on the home visitation of infants. Many have, also, established infant welfare centres for the medical supervision of children. Although, when there is active local administration, this is convenient for working the Act, inconvenience is experienced in relating the work of the midwife as closely with that of the health visitor as is desirable, especially in view of future developments of ante-natal work. By friendly co-operation between the county council and the borough or urban district council, a working arrangement should always be practicable.

Apart from these large administrative units within the county, and certain other exceptional instances, experience points to the conclusion that it is in most instances more economical for the county council to adopt the Act, arranging friendly co-operation with the local sanitary authorities within its area. In this way arrangements can be made for carrying out satisfactory ante-natal,

natal and post-natal work. In this way also whole-time health visitors can be employed. If the districts adopt the Act separately, the majority of them are not sufficiently large to utilise a whole-time health visitor, and combinations with neighbouring authorities for this purpose are liable to fall through.

Where the work is carried out by the county council it is possible and often desirable to unite the offices of assistant inspector of midwives, infant visitor and tuberculosis visitor in one adequately-trained health visitor, thus saving time in travelling by enabling the visitor to have a smaller district allotted to her than if she undertook only one branch of work. In some counties the school work is also undertaken by the health visitor. It is desirable to apportion the time devoted to each subject.

In dividing the administrative county into areas of work for health visitors, it has been found important to have regard to means of locomotion and to the boundaries of the local sanitary areas; and still more to arrange for the health visitor to be in close touch with the medical officer of health of the local sanitary authority or authorities in whose districts she works, and to report insanitary domestic conditions to him. The county health visitors should be supervised either by an assistant county medical officer or by some other adequately qualified person.

In some areas arrangements have been made for infant visiting to be carried out by district nurses who are also midwives. This method presents the disadvantages that the area which a district nurse or midwife can serve is small: that under these circumstances it is impracticable to combine the offices of inspector of midwives and infant visitor; that the number of officers, owing to the small areas served, is great, and it is difficult to secure accurate records of the progress of infants; and that usually such nurses have had no sanitary training and are unable to detect and report domestic insanitation. The establishment of infant welfare centres in some of the rural areas is more likely to be secured when ante-natal and post-natal home visitation of infants has been established.

Voluntary workers.—Much of the success so far achieved in improving the health conditions of infancy and childhood has been secured by co-operation between voluntary and official workers. Excellent work has been done by local and other societies, particularly in the last ten years, in educating public opinion and in direct assistance to mothers and their infants. Special mention should be made in this connection of the various conferences of The National Association for the Prevention of Infant Mortality, presided over by the late President of this Board, which have been largely instrumental in stimulating both official and voluntary workers.

In the light of this review of past progress, some of the branches of child welfare work, as enumerated in the scheme on page xxi, may now be discussed.

The branches of child welfare work considered in the 2nd Report on Infant and Child Mortality have undergone great expansion during 1913: and it has become increasingly evident that extensions of this work so as to influence the earliest period

of infancy are necessary, in order to promote adequately the health and well-being of young children (*see* p. xix).

The necessity for such extension may best be discussed after a statement of the national statistics as to dead-births and as to birth-rates.

Dead-births.—In addition to the large proportion of the total infant mortality after birth which is due to infectious and other conditions arising in the ante-natal period, a large loss of life also occurs before birth. Some measure of this loss is given by the Notification of Births Act which, in the areas in which it has been adopted, imposes the duty of notifying to the medical officer of health not only live births, but also dead-births occurring after the 28th week of pregnancy. From returns kindly made to me by the medical officers of health of the 29 metropolitan boroughs, of the 74 county boroughs and large towns in England and Wales with a population exceeding 50,000, and of the 67 smaller towns with a population between 20,000 and 50,000 in which the Notification of Births was in force, I have compiled the following tables as to dead-births.

The following table shows the average percentage of notified dead-births to registered (live) births in London and in towns and county boroughs where the Notification of Births Act, 1907, is in force.

—	1910.	1911.	1912.	1908 to 1912 or other period.	Range of percentages for 3 years 1910-12.
In 74 county boroughs and towns with over 50,000 population.	3·01	3·18	2·98	3·06	1·08 to 5·52
In 67 towns with populations be- tween 20,000 and 50,000.	3·21	3·07	3·34	3·34	1·19 to 7·82
In the 29 metropolitan boroughs	2·14	2·21	2·46	2·18	0·31 to 5·83

In the following table is given the range of variation of notifications in each group of towns, separately for each year from 1908 onwards.

—	Number of areas.	Average percentage of dead births to registered births.	Range.
	1908.		
Metropolitan boroughs	7	1·43	0·36-2·54
Large towns	17	3·04	0·72-5·06
Smaller towns	12	4·02	1·17-7·31
	1909.		
Metropolitan boroughs	17	2·08	0·61-3·34
Large towns	46	3·10	0·63-9·65
Smaller towns	24	3·61	1·58-8·07

				Number of areas.	Average percentage of dead births to registered births.	Range.
				1910.		
Metropolitan boroughs	...	...	...	28	2.14	0.73-3.33
Large towns ...	...	...	...	52	3.01	1.18-7.65
Smaller towns	...	...	...	34	3.21	1.65-6.70
				1911.		
Metropolitan boroughs	...	...	...	27	2.21	0.69-3.44
Large towns ...	...	...	...	58	3.18	1.24-5.95
Smaller towns	...	...	...	40	3.07	0.96-7.01
				1912.		
Metropolitan boroughs	...	...	...	27	2.46	0.31-3.30
Large towns ...	...	...	...	60	2.98	1.24-5.32
Smaller towns	...	...	...	54	3.40	0.92-8.40

The great range in the proportion of dead-births to registered (live) births makes it clear that a large and variable proportion of dead-births remains unnotified. It appears likely that in the practice of midwives the dead-births amount to about 3 per cent. of all the births attended by them. Dr. Routh, on the basis of a wide series of observations by many authorities over a large field, estimates that abortions at an earlier period of pregnancy are four times the number of dead-births. This would imply a total ante-natal mortality of 150 per 1,000 births, which is much higher than the total mortality in the first year after birth. From evidence published by the Royal Commission on Venereal Diseases, it appears likely that one-half of this ante-natal mortality is ascribable to syphilis. To the ante-natal mortality must be added the large proportion of infant mortality after birth due to ante-natal accidents and disease.

Reduction in the birth-rate.—There has been a striking fall in the birth-rate in recent years, which emphasises the importance of the statements in the preceding paragraph. Between 1876-80 and 1912 the Registrar-General states that the fall in the birth-rate, calculated on the total population, has amounted to 33 per cent.; while the fertility of married women, *i.e.*, the ratio of legitimate births to wives of conceptive ages, has shown a decrease of 35 per cent. In other words if the fertility of married women in proportion to their numbers had been as high in 1912 as in 1876-80 the legitimate births in that year would have numbered 1,290,480, instead of the 835,209 actually recorded.

Dr. Stevenson in his report for 1912 has a valuable comparison of fertility in relation to social status (p. xxiii). The birth-rates in each of eight social groups are stated per 1,000 married *men* aged under 55 years in that group; the population data according to social status being taken from the census returns. Although this method of statement is not the best, it is the best available until next year, when more accurate fertility data based on occu-

pational figures for *women* will be published. Meanwhile the fertility figures given in the report for 1912 may be taken to be roughly comparable. In the following table I have used them for comparison with the rates of infant mortality for the same eight social groups published in the Registrar-General's annual report for 1911. In this table the percentage deviation from the average infant mortality and from the average fertility-rate (as determined by the above rough and preliminary test) is shewn.

Fertility Rates and Rates of Infant Mortality in different Social Strata.—(Percentage Deviation from corresponding Rates for England and Wales.)

Number.	—	Fertility Rates.	Rates of Infant Mortality.
		Per cent.	Per cent.
I.	Upper and middle class	— 27	— 39
II.	Intermediate class	— 19	— 15
III.	Skilled workmen	— 6	— 10
IV.	Intermediate class	— 2	— 3
V.	Unskilled workmen	+ 31	+ 22
VI.	Textile workers	— 23	+ 19
VII.	Miners	+ 42	+ 28
VIII.	Agricultural labourers	— 1	— 22
	All classes	100	100

It will be noted that in the first five chief groups the fertility rates and the rates of infant mortality vary in the same direction, the infant mortality being highest among the populations having the highest birth-rates. This is an average result. The facts set out in the recently issued report on Infant Mortality in Lancashire (Cd. 7511, pp. 21-22) show that there are numerous exceptions to this rule; as also do the facts in the preceding reports on Infant Mortality (Cd. 5263, pp. 48-49 and Cd. 6909, pp. 56-58). Two of the three last items in the above table illustrate the same fact. In the textile industries, employing 3·4 per cent. of the total male and 4·4 per cent. of the total female population of England and Wales, aged 10 and upwards, fertility and infant mortality vary widely in opposite directions; and among agricultural labourers, who number 4·6 per cent. of the total male population aged 10 and upwards the infant mortality is very low with a nearly average rate of fertility.

Miners, who compose 6·7 per cent. of the total male population aged 10 and upwards have an excessive infant mortality, and a fertility exceeding to a still greater extent the average for the whole country.

The figures quoted above appear to be consistent with the view that, outside the range of extreme poverty, there is no unavoidable relationship between a high birth-rate and a high rate of infant mortality. The two rates vary inversely in the case of textile workers, among whom the practice of purposeful avoidance of fertility is stated to be common. Here a low birth-rate, without

removal of unfavourable industrial and sanitary conditions is associated with a high rate of infant mortality. The families of agricultural labourers appear to be of average size. They are, however, free from the risk which town life and industrialism imply for infancy, and their infant mortality is 22 per cent. below the average. The conditions leading to excessive infant mortality among mining populations have been fully discussed in three previously issued reports on infant and child mortality.

Extent of present ante-natal public health work.—In order to ascertain precisely to what extent ante-natal work is already being carried on, the medical officers of health of all the county boroughs were asked in March last to answer the following questions, and I take this opportunity to thank them for the information thus obtained.

The following questions were asked:—

1. Is there any infant consultation or similar organisation in _____ ?
2. In connection with these consultations, have arrangements been made in any instance for expectant mothers to consult the physician at the consultation?
3. Is there any arrangement for expectant mothers to receive advice, treatment, or other assistance in connection with any organisation other than 2, *e.g.*, the out-patient department of a general or maternity hospital?
If so, please give any particulars obtainable.
4. Are there any arrangements for visiting expectant mothers?
If so, how is the information as to the expected birth obtained, and how is the visiting organised?
5. Please set out any known arrangements—
(A) at a Lying-in Hospital, or
(B) at a Hospital to which a Medical School is attached for ascertaining the condition of health of the expectant mother when she enters her name for attendance in confinement, including any arrangements for Wassermann tests in suspicious cases, and any advice in cases of contracted pelvis, &c.
6. Is there any system of instruction to midwives, which will make them better informed as to the circumstances in which—when expectant mothers engage them to attend their confinements—they should recommend an early medical consultation?
7. Do arrangements exist apart from the ordinary facilities of medical practice, to enable the midwife to secure medical aid in emergencies of pregnancy, *e.g.*, hæmorrhage?
8. Do similar arrangements exist for women in labour?

The answers to the return show that, both in connection with infant consultations and with the work of home visitation, a considerable amount of work among expectant mothers is carried out.

Systematised work is rendered difficult owing to absence of any knowledge of the fact that a woman is expecting her confinement. Information may be obtained on this point from two main sources, namely, the maternity departments of hospitals, and the midwives of the district.

Both these methods have been resorted to in Leeds. The Public Health Office have made an arrangement with the maternity hospital to forward regularly a list of all the women who have applied for maternity aid, and the women are then visited by the municipal health visitors at intervals up to their confinement, and in most instances also afterwards. The Leeds Babies'

Welcome Association have special afternoons on which expectant mothers are seen at several centres by health visitors, and midwives are asked to refer expectant mothers to the centres. In Newcastle-on-Tyne and in Warrington special attention is also directed to getting into touch with expectant mothers by the Public Health Departments and by the voluntary agencies working in co-operation with these. In both these towns the inspector of midwives is in close co-operation with the Infant Welfare Centres, as are all the municipal health visitors.

In St. Helens, the town council have recently arranged with midwives to notify cases of pregnancy for which they are engaged to the Health Department, whose staff will then visit the mother.

Ante-natal work in connection with the hospitals in the metropolitan area having large maternity out-patient departments.

Special inquiry into this branch of ante-natal work was made by Dr. Lane-Claypon. It was found that arrangements for some form of ante-natal visiting of expectant mothers applying for maternity aid exist in connection with the maternity departments of several of the metropolitan hospitals. These arrangements for the most part are made with voluntary agencies, working chiefly by means of salaried visitors who visit the mothers at regular intervals both before and after their confinement and report to the hospital's almoner as to domestic and social conditions.

Most of these hospitals arrange for the medical examination and, if necessary, treatment of women in their first pregnancy, or of others with histories of previous difficult confinements; and at a few hospitals all women applying for aid are seen by a member of the medical staff.

At St. Thomas's Hospital there is a much more elaborate organization comprising a large part of the work of a complete maternity centre. All women applying for maternity aid are seen first by a medical officer and then by the almoner. The medical officer decides at once, if possible, whether the case shall receive in-patient or out-patient treatment at her confinement, and the almoner obtains information as to the circumstances and home conditions of the patient. The almoner has a staff of visitors, who visit the women in their own homes and report to her; wherever possible, the services of voluntary agencies, working in the various boroughs in which the hospital district lies, are also utilised.

The voluntary agencies, most of which have at least one salaried and trained worker, undertake to visit the homes. At the visits, further information is obtained for the hospital almoner if needed, and efforts are made to induce the mother to make suitable preparation for the expected infant both as to clothing and to general home conditions. In the event of any ailment supervening, the woman is advised to attend the hospital, and this is facilitated by the fact that she may attend for medical advice or treatment on any day in the week.

These home visits appear to have led to much improvement in the general cleanliness of the homes, and to better preparation for

the infant. Where the needed improvements are not effected, the mother is recommended to go to the infirmary for her confinement. The confinements in the homes are attended from the hospital, the supervision of the mother and infant being continued up to at least one year of age, and often much longer. The home visitation is continued by the same agency which visited before the birth of the infant, and all the mothers are induced if possible to bring the infant for medical supervision to an infant welfare centre. One of those centres is at the hospital itself, and is in charge of a member of the medical staff who also attends at a second centre in a different part of the district. Every infant attending the centre is seen by the medical officer.

Where it is more convenient for mothers to attend at centres other than those mentioned, they are referred by the visitors to neighbouring institutions. Many of the children are kept under observation up to the age of school attendance.

Hospitals with maternity departments offer admirable facilities for the work outlined above. They are directly in touch with the pregnant mother, and can thus secure the best ante-natal attention whenever required. Incidentally the organisation has a great medical value for both undergraduate and post-graduate teaching in medicine. The study of minor ailments of pregnancy as well as of its more serious complications, and instruction in methods of treating and preventing them and in the prevention and treatment of infantile ailments from the earliest age up to school age, are not only of great importance to the patients themselves but equally so to every medical student and practitioner.

The importance attaching to clinical instruction in infant hygiene has been recently illustrated by the following resolutions signed by Sir Thomas Barlow on behalf of the Executive Committee of the National Association for the Prevention of Infant Mortality.

That degree and licence-conferring bodies should require from each candidate for the final examination in medicine a certificate of having attended a course of clinical instruction on infant hygiene, to include lectures or demonstrations on the management of infants, and the prophylaxis and treatment of infantile diseases.

Such a course should include instruction in the part played by the State in infant hygiene, with special reference to the duties and functions of the medical practitioner, the midwife, the hospital and local sanitary authorities, and the health visitors.

The certificate required from candidates in midwifery for the final examination should include evidence that they have received instruction in ante-natal pathology and hygiene, and in the management of infants during labour, the puerperium, and the period of lactation.

In most centres of medical education facilities for introducing teaching on the lines indicated above already exist, and it would further infant welfare work to a great extent if every medical practitioner had the advantage of receiving such a course of instruction.

The organisation of Maternity Centres.—The preceding illustrations of ante-natal work already begun give some indication of the general scope and character of one part of the work of a maternity centre. If there is a local maternity charity, this may advantageously be utilised as part of the scheme in developing

new work. The co-operation of the local midwives is indispensable in order that the necessary information may be obtained as to expectant mothers for whom medical advice is needed. "Maternity centres" as advised in the Board's circular letter printed on page xix constitute the most satisfactory means for organising the medical care of expectant mothers, of mothers during and after confinement, and of them and their infants until the latter are entered on a school register. The work of such a centre, when complete, would comprise the items enumerated under the first four chief headings and the nine sub-headings comprised in the scheme printed on page xxi; and the recently authorised grants for child welfare work will enable an immediate beginning to be made by sanitary authorities and county councils on these lines. It will be noted that among the subjects for grants are the salaries of present health visitors and officers of infant consultations already in operation.

The essential point is to aim at securing medical aid and guidance for the mother and child from before the birth of the child until school attendance begins, both by means of home visitation, and by attendance at a centre for medical advice, and if necessary, treatment. It is also important that there should be close co-operation between the midwives and health visitors and the maternity centre; and that overlapping with any existing voluntary agencies should be avoided.

Mortality in connection with Maternity.—The need for additional maternity work is shown in the national mortality figures. This is the case whether the figures for infantile or for maternal mortality are considered.

(a) *Infant Mortality due to Maternal Conditions.*—Of the total deaths of infants in the first year after birth, about one-fifth occur in the first week after birth, one-third in the first month after birth, and over one-half in the first three months after birth. Nearly all the deaths in the first week, and most of the deaths in the first month of life are attributable to ante-natal and natal conditions. That this toll of lives is largely avoidable is shown by the great variations in its amount in different parts of the country. Thus, quoting from my Second Report on Infant and Child Mortality (p. 27), the death-rate in the first week of life was 33 per cent. below the average for the 241 towns in Hornsey, and 30 per cent. below the average in Heywood, as compared with 10 per cent. above the average in Middlesbrough and 70 per cent. above the average in Dewsbury and in Workington. In the first month of life it was 36 per cent. below the average in Watford and 32 per cent. below in Penge, as compared with 44 per cent. above in Batley and in Blyth.

(b) *Adult loss of life in connection with Maternity.*—In the year 1912, the number of deaths assigned to pregnancy or child-birth in England and Wales was 3,473,* corresponding to a rate of 3·98 per 1,000 births. Of this number, 1,216 were caused by puerperal fevers. The following statement of deaths from puerperal fever and the accidents and diseases of pregnancy and

* Including puerperal renal disease which, prior to 1911, was not included under this heading.

childbirth* enables a comparison to be made with previous years:—

Ten years 1897-1906	...	Death of one mother to 228 births.
Year 1907	...	261
" 1908	...	280
" 1909	...	271
" 1910	...	281
" 1911	...	272
" 1912	...	265
" 1913	...	270

In the following figures the facts for puerperal fevers and for all other causes of deaths ascribable to pregnancy or parturition are set out for a series of years. It will be noted that there is a steady decline in the death-rate from puerperal fevers; but it cannot be regarded as satisfactory that septic contamination in connection with child-bearing still accounted for 1.216 deaths in the year 1912. It is noteworthy that the incidence of puerperal fevers and of other diseases affecting pregnancy and childbirth varies greatly in different parts of the country.

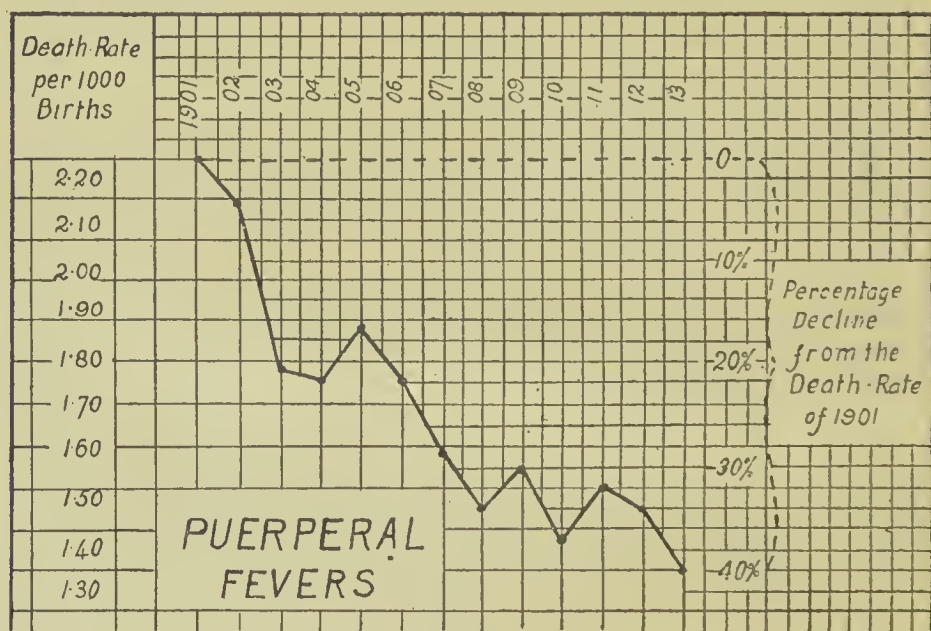


Fig. 3.

England and Wales.—Annual Death-rate per 1,000 Births from Puerperal Fevers, 1901-13.

Thus, the average rate per 1,000 births from these causes varied in registration counties during the ten years 1900-9 as shown in the following extreme examples:—

Huntingdonshire	...	2.59	Lancashire	...	4.85
Middlesex	...	2.98	West Riding. Yorks	...	4.93
Essex	...	3.05	Westmorland	...	5.11
London	...	3.09	Cumberland	...	5.39
Surrey	...	3.13	Wales (variations in different counties from)	...	4.36 to 7.01

* Not including puerperal renal disease.

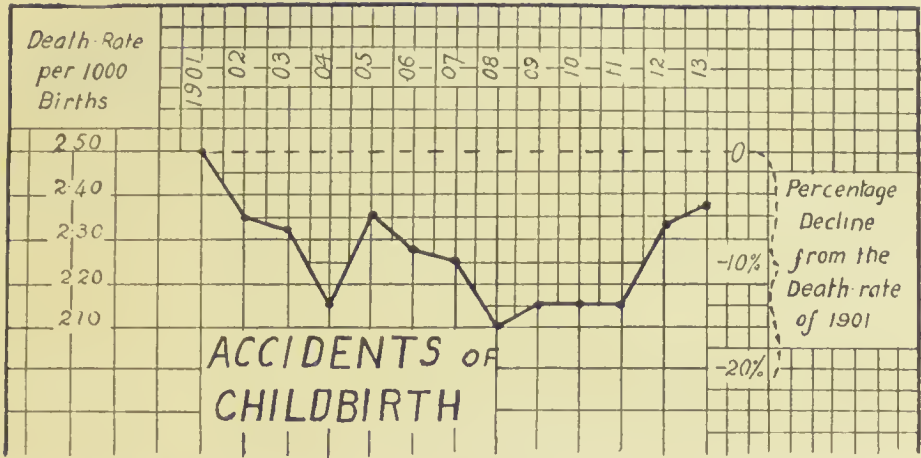


Fig. 4.

England and Wales.—Annual Death-rate per 1,000 Births from Accidents and Diseases of Pregnancy and Childbirth, 1901-13.

The curve for accidents and diseases of pregnancy and childbirth shows an unsatisfactory course, and emphasises the need for maternity centres at which expectant and parturient mothers may receive treatment.

In addition it is well known that a large mass of non-fatal sickness of a chronic and disabling character is caused by unsatisfactory attendance in confinements, and by failure to recognise the constitutional and other conditions (including sepsis and syphilis) occurring in pregnancy or after childbirth.

Health visiting.—A memorandum on health visiting with special reference to its relationship to the work of maternity centres by Dr. Janet Lane-Claypon, a medical inspector of the Board, is given on p. 72. This will be found useful for health visitors in securing the giving of suitable advice on a number of important points.

SECTION IV.

THE ACUTE INFECTIOUS DISEASES.

Notifications of Infectious Diseases.

In March last the third annual statement of statistics of the incidence of notifiable infectious diseases in each sanitary district in England and Wales was issued. This statement (N.S. 89) gave the number of cases and the case-rate per 1,000 of population for each of the chief notifiable diseases for each of these districts, excepting tuberculosis.

In the following table the number of cases reported in each of the years 1911-13 and the corresponding case-rates for each disease are given.

	Number of Cases Reported						Number of Cases per 1,000 of Population.					
	In London.*			In England and Wales.*			At Ports.			London.		
	1911.	1912.	1913.	1911.	1912.	1913.	1911.	1912.	1913.	1911.	1912.	1913.
Small-pox ...	72	4	3	265	109	88	30	12	25	0·02	0·00	0·01
Typhus fever ...	1	3	5	55	31	11	—	—	—	0·00	0·00	0·00
Scarlet fever ...	10,500	11,328	17,568	104,617	107,477	130,626	34	31	81	2·33	2·51	2·90
Diphtheria ...	7,404	7,109	7,668	47,747	44,687	50,850	55	67	53	1·64	1·57	1·33
Enteric fever ...	1,024	701	762	13,730	8,262	8,117	122	124	146	0·23	0·16	0·38
Continued fever ...	23	8	14	176	97	108	3	8	9	0·01	0·00	0·00
Relapsing fever ...	—	—	—	1	—	—	—	—	—	—	—	—
Puerperal fever ...	305	383	354	2,029	2,184	1,989	—	—	—	0·07	0·08	0·06
Erysipelas ...	4,904	4,137	4,159	24,939	22,865	23,114	11	21	18	1·09	0·91	0·92
Cerebro-spinal fever ...	102	103	86	134‡	267‡	278	—	—	1	0·02	0·02	+
Poliomyelitis ...	69	135	142	268‡	839‡	744	—	—	1	0·02	0·03	+
Cholera ...	—	—	—	—	—	—	—	—	—	—	—	+
Plague ...	—	—	—	1	1	—	—	2	—	—	0·00	0·02

* Excluding cases notified at ports.

† Including all cases notified at ports.

‡ Cerebro-spinal fever and poliomyelitis were not compulsorily notifiable in the whole of England and Wales until 1st September, 1912.

SCARLET FEVER.

The mortality in England and Wales from this disease year by year since 1901 is shown in Figure 5.

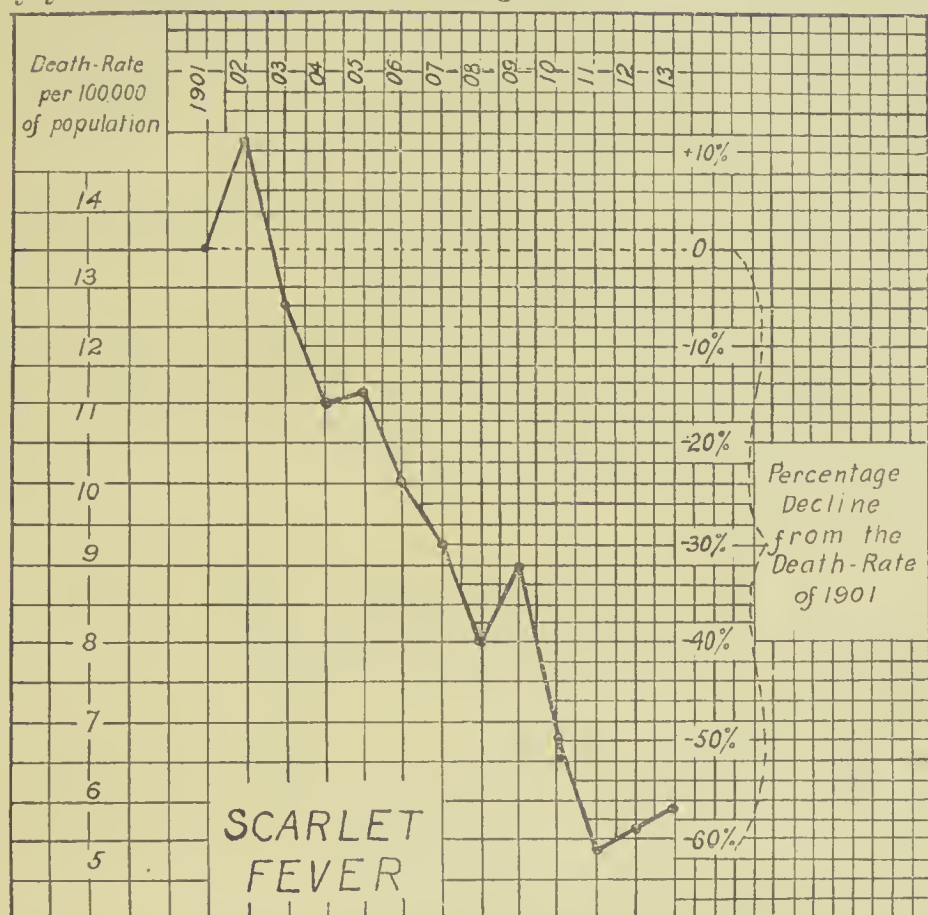


Fig. 5.

England and Wales.—Annual Death-rate from Scarlet Fever, 1901-13.

Exclusive of ports, 130,626 cases of scarlet fever were notified in England and Wales in 1913, as compared with 107,477 in 1912, and 104,617 in 1911.

The incidence of the disease in relation to the population in the entire country, excluding ports, and in certain parts of it is shown in the following table:—

Scarlet Fever—Sickness Rates per 1,000 of population.

—	England and Wales.	England.	Wales (including Monmouth).	London.	Aggregate of Administrative Counties of		Aggregate of County Boroughs of	
					England (excluding London).	Wales (including Monmouth).	England.	Wales (including Monmouth).
1911	2.90	2.84	3.66	2.33	2.71	3.62	3.32	3.85
1912	2.98	2.95	3.35	2.51	2.77	3.32	3.46	3.46
1913	3.57	3.51	4.52	3.89	2.96	4.40	4.26	5.05

In London the highest rates occurred in Bermondsey, 5·86; Deptford, 5·71; and Battersea, 5·67. The lowest rates in London occurred in Stoke Newington, 2·15; Westminster, 2·40; and Hampstead, 2·45.

In county boroughs the highest rates occurred in Birmingham, 10·19; South Shields, 10·16; Newport (Mon.), 9·55; Gloucester, 8·09, and Smethwick, 8·07. The lowest rates in county boroughs occurred in Chester, 0·69; Wigan, 0·81; Halifax, 1·11; Stoke-on-Trent, 1·13; Bolton and Reading, 1·15.

The highest rates for the administrative counties as a whole occurred in Monmouth, 8·81; Northumberland, 6·23; Durham, 5·93; Glamorgan, 4·85; and Derby, 4·81.

The lowest rates for administrative counties as a whole occurred in Huntingdonshire, 0·84; Suffolk (West), 0·88; Rutland, 0·93; Soke of Peterborough, 1·08; and Dorset, 1·15.

The number of deaths from scarlet fever in 1913 was 2,093, which, on the cases notified, gives a fatality of 1·60 per cent.; the corresponding figures for 1911 and 1912 were 1·81 and 1·86 per cent. respectively.

For the most part the disease during 1913 seems to have been of the mild type prevalent during recent years, and this is evidenced by the low fatality rates above given. The fatality figures are not, however, of the same order in different parts of the country; and in this connection reference may be made to the figures given by Dr. Stevenson in the 75th annual report of the Registrar-General (Table XLVI.), which show that county boroughs, urban districts, and rural districts in the northern part of England showed a higher fatality rate from scarlet fever than corresponding areas in the Midlands, South of England, and Wales. Though allowance must be made for the varying completeness of notification and diligence in searching out unnotified cases in different areas, it is likely that these differing fatalities correspond in the main to real differences in the behaviour of scarlet fever.

In a special report on an epidemic in Sunderland Rural District, Dr. Stobo, the Medical Officer of Health, stated that "the present epidemic has been notorious for the large percentage of severe cases of the septic type with all the complications common to that type, and in many cases the symptoms were so severe as to make the prognosis grave from the first." About 30 per cent. of the patients had a history of diarrhoea during the first day of illness, and one-third of the notified cases were, in the opinion of the medical officer of health, of a "septic type," characterised by unusually severe inflammation of the throat with enlarged cervical glands and rhinitis. Among the 340 cases notified during 1913, 14 died, giving a case mortality of 4·1 per cent. In this district the fatality of scarlet fever for the eight years 1905-12 inclusive was 1·1 per cent., whereas the fatality from 1st January, 1913, to 28th February, 1914, was 4·5 per cent. In this, as in some other recent outbreaks, there is evidence of an occasional reversion to the more severe form of scarlet fever of former years.

An outbreak of scarlet fever in Woodbridge Rural District attributable to milk infection was investigated on behalf of the

Board by Dr. Fletcher. There were 76 cases of the disease which occurred in four parishes in April and May, 1913. During 13 days of this period, April 24th to May 6th, 56 cases occurred and 41 dwellings were invaded. The type of the disease was relatively severe, seven of the cases being fatal. The circumstances of the milk supply to the four parishes were complicated and troublesome to analyse, but it appeared that the milk from a certain farm, distributed either unmixed or mixed with milk from other farms, was probably responsible for the outbreak. The source of infection of the milk at the farm in question could not be definitely ascertained. The salient features of this epidemic are given in Appendix A, No. 3.

Other instances in which milk appears to have been the agent of infection have come to the Board's notice during the year. These include outbreaks in two large boroughs. In large centres of population, at times when scarlet fever is generally prevalent, an accession of scarlet fever due to the infection of local milk supplies may easily pass unnoticed unless the possibility of this occurrence is borne in mind, and systematic inquiries are made as to the milk supply.

DIPHTHERIA.

The general course of the mortality from this disease in England and Wales as a whole is shown in Fig. 6.

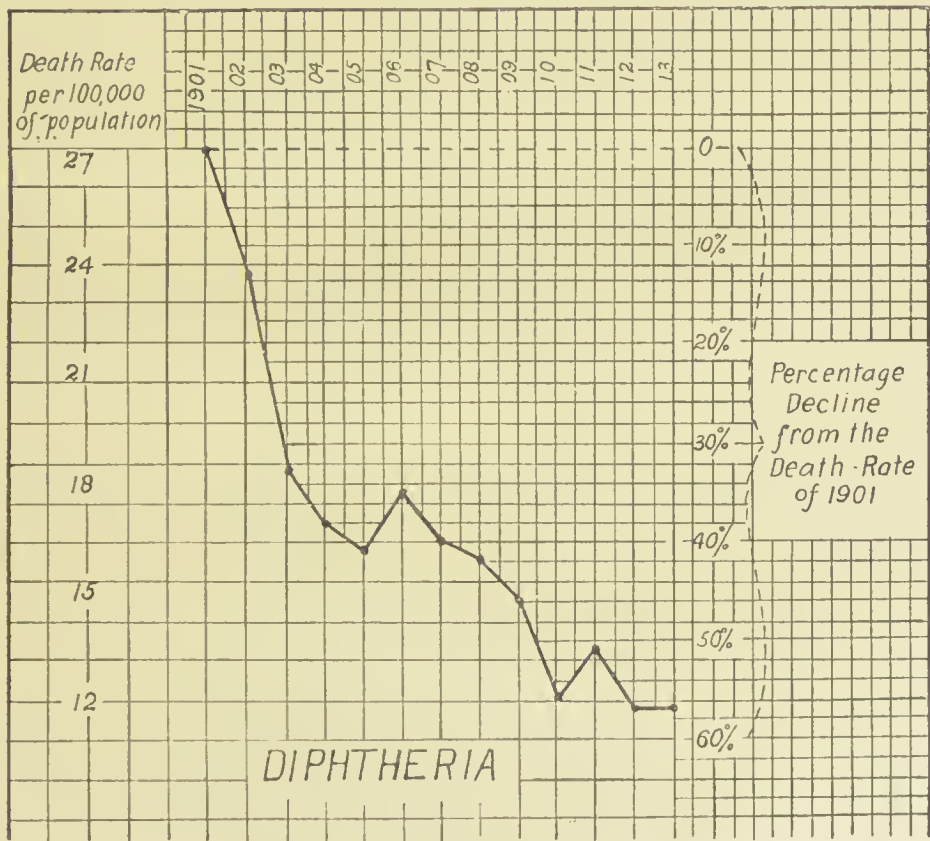


Fig. 6.

England and Wales.—Annual Death-rate from Diphtheria, 1901-13.

Excluding ports, 50,850 cases of diphtheria were notified, as compared with 44,687 in 1912 and 47,747 in 1911.

The incidence of the disease in relation to population in the entire country, excluding ports, and in certain parts of it is shown in the following table:—

Diphtheria.—Sickness Rates per 1,000 of Population.

—	England and Wales.	England.	Wales (including Monmouth).	London.	Aggregate of Administrative Counties of		Aggregate of County Boroughs of	
					England (excluding London).	Wales (including Monmouth).	England.	Wales (including Monmouth).
1911	1·32	1·33	1·30	1·64	1·22	1·21	1·47	1·68
1912	1·24	1·24	1·27	1·57	1·10	1·13	1·32	1·84
1913	1·39	1·39	1·40	1·70	1·26	1·30	1·48	1·86

In London, the highest rates occurred, as in 1912, in Woolwich 3·30, and Greenwich 2·72. The lowest rates in London occurred in Hammersmith 1·12, Chelsea 0·93, and in Kensington 0·84. In Kensington in 1912 the rate was 1·0.

In county boroughs the highest rates occurred in Portsmouth 4·00 (4·5 in 1912), Norwich 3·20, Cardiff 3·02 (2·9 in 1912), Southampton 2·95, and Barrow-in-Furness 2·71 (3·1 in 1912). The lowest rates in county boroughs occurred in Dudley 0·25 (0·1 in 1912), Oxford 0·35 (0·2 in 1912), Wigan 0·38 (0·4 in 1912), Dewsbury 0·54, and Bootle 0·55.

The highest rates for administrative counties as a whole occurred in Flint 2·08, Anglesey 2·06, Soke of Peterborough 1·97, Westmorland 1·91, and Bedford 1·88. The lowest rates for administrative counties occurred in Suffolk (West) 0·22, Buckinghamshire 0·31, Oxfordshire 0·37, Huntingdonshire 0·39, and Isle of Wight 0·49.

During the year a number of local outbreaks of diphtheria were investigated by medical inspectors, and such advice as was needed was given to the sanitary authorities concerned. The following notes relate to some of these outbreaks.

The prevalence of diphtheria at Sherborne and at Dorchester was investigated by Dr. Arnold, the former at the request of the Urban District Council of Sherborne, and the latter on the application of certain residents to the Board.

Sherborne Urban District had a population in 1911 of 5,953. Cases of diphtheria had been notified towards the end of the year 1912 and at the beginning of the year 1913. In May there was an extension of the outbreak, and to the end of August 49 cases were notified. The type of the disease was mild, and infection appeared to have been spread, in the main, by personal contact. During the extension of the outbreak suspicion fell on milk as a possible factor in spreading the disease, but no definite proof

of this was reached. The arrangements for the isolation of cases of infectious disease in hospital were found to be inadequate and unsatisfactory.

The Borough of Dorchester, population 9,842 at the census of 1911, had been fairly free from diphtheria from 1907 to 1911, the average number of cases notified being 6.6 per annum. In 1912, 34 cases were notified and 88 in 1913. The scholars of a particular infant school were excessively attacked as compared with the general child population. The borough was found to be insufficiently provided in regard to disinfecting apparatus and in regard to accommodation for the staff at the isolation hospital.

An outbreak of diphtheria which occurred in the Rochford Rural District was investigated by Dr. Hutchinson. The outbreak was practically limited to the village of Great Wakering, and 23 out of 33 cases attended the local school. The disease appeared to have spread by personal contact of children at school and in their homes, milk having played no part in the outbreak. Insanitary conditions were found at the school and in the village, where a proper system of sewerage and sewage disposal is needed.

It was found that the then medical officer of health had not carried out his duties satisfactorily, and that there was lack of co-operation between him and the inspector of nuisances. Moreover, the inspector of nuisances was over-weighted with the multiple duties which, though they were unconnected with his work as an inspector of nuisances, the rural district council required him to perform.

The local prevalence and persistence of diphtheria in the Borough of Luton was investigated by Dr. Arnold. This town has a population of some 53,000 persons, and, in the last six months of 1913, 145 cases of diphtheria occurred in 119 houses. The local action as regards spread of infection appeared to be fairly satisfactory except in the important respect that the isolation hospital provision was inadequate, especially in view of the fact that Luton has a large industrial population, including many outworkers.

Dr. Macewen inquired into the circumstances associated with an outbreak of diphtheria, comprising 52 cases, in the borough of Worthing (population in 1911, 30,305). Two children notified as suffering from diphtheria resided in a cottage at a dairy farm within the borough. Disinfection of the premises and removal of the patients were promptly carried out, and the milkers in the family were kept away from work. Eight days after the removal of the children from the farm cottage, a milker from the farm returned to milking, and three days later a case of diphtheria was notified in the town followed on successive days by five and eight further cases. The families to which these cases belonged obtained their milk from dairies supplied from the farm in question. It was at this stage found that the milker had returned to his work, and that he was suffering from diphtheria.

The medical officer of health for the Winsford Urban District applied to the Board for assistance owing to the continued prevalence of diphtheria in the district. Dr. Copeman, who inves-

tigated the outbreak, found no evidence that there had been infection by means of milk or other foods, and school attendance was not specially concerned. The disease had continued for many months with occasional remissions, and it was of a mild type. There were few secondary cases in houses, and a considerable proportion of adults was attacked.

The Winsford Urban District is composed of two sharply defined districts, Wharton and Over, separated from each other by the River Weaver. In Wharton the incidence of the disease on population has been four times as great as in Over. Wharton comprises the more insanitary area of the urban district, but beyond this fact no circumstance associated with its disproportionate rate of attack was discovered. Dr. Copeman draws attention to the scavenging methods adopted in the two districts. Until recently, all house refuse in Wharton was dumped on to the roadways, there to await collection by the council's scavenging staff. This procedure was followed, but to a much less extent, in Over. There was some scarcity of water, and the watering of streets was not efficiently dealt with in dry weather. Dr. Copeman suggests that the inhalation of dust which is blown about in large quantities may have caused sore throats and favoured subsequent diphtherial infection, or may even have been an occasional medium for its conveyance.

Dr. Macewen investigated and reported to the Board on an outbreak of diphtheria in South London attributable to milk infection.*

The dairy supplying the infected milk served six different districts, comprising three metropolitan boroughs, one county borough, and two urban districts. Credit is due to the medical officers of health of the respective districts for their prompt recognition of the cause of the outbreak and for the active steps taken by them to suppress it. Pasteurization of the milk was instituted, on the instigation of Dr. Priestley, the medical officer of health of Lambeth, and, following on this, the epidemic ceased. The efficiency of pasteurization, when properly carried out, in rendering harmless a milk contaminated with an easily killed organism like the diphtheria bacillus, was well illustrated by this outbreak.

The investigation involved in tracing the source of infection was complicated by the fact that not only was the infected milk supplied within six sanitary areas, but that also it was derived from seventeen farms situated in various parts of the counties of Surrey and Sussex, as well as from the dairyman's own cows in Lambeth. As a first step, a letter asking for information and requesting a strict examination of each farm and of the milkers, &c. employed on it was sent; and this at once elicited important positive information in respect of one farm from Dr. Child, the medical officer of health of the West Sussex northern combined districts. Information from all the other farms concerned was negative.

* Report by Dr. Hugh A. Macewen to the Local Government Board on an Outbreak of Diphtheria in South London attributable to milk infection. New Series No. 94, 1914.

At the farm in question at Horsham, several of the cows had sores on the udder and teats, and three out of the four milkers on the farm were affected in a like manner on their hands. From sores on the hands of two of the milkers virulent diphtheria bacilli were isolated, while swabs from their throats gave negative results. The presence of the diphtheria bacillus in lesions other than those of the throat was an interesting feature of this outbreak.

Unfortunately, the sores on the teats of the cows at the date of examination were practically healed, and it was impossible to take swabs from them with a view to discovering whether they also contained the diphtheria bacillus.

In view of the attendant circumstances, it seemed probable that the sores on the milkers' hands were caused by direct contact with the sores on the teats of the cows in the process of milking. On this hypothesis, the explanation of the outbreak appears to be that sores on the cows' teats became infected with diphtheria from some unknown source; and that the infectivity of the milk for its human consumers was increased owing to the accidental infection of the milkers' hands from the diseased teats.

Typhus Fever.

During the eleven years 1902-1912 the number of deaths from typhus fever was as follows:—

—	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	1911.	1912.
England and Wales ...	61	69	37	38	9	24	13	15	5	10	12
London ...	0	3	0	0	0	0	0	0	0	0	0

In the last three years the following notifications of typhus have been received:—1911, 55; 1912, 31; 1913, 11. These figures do not include cases notified but subsequently found not to be typhus.

In several instances typhus was notified during 1913 in error and the notifications were subsequently withdrawn and corrected. Eighteen cases remained notified as typhus, and were so recorded in the annual summary of infectious diseases for 1913 (N.S. No. 89). Seven of these, however, appear from data now available not to have been cases of this disease. Of the 11 notified cases probably or certainly typhus, one was notified in each of the two metropolitan boroughs, Bermondsey and Shoreditch, and two in the metropolitan borough of Stepney; four cases were notified in the city of Liverpool, one in the county borough of Wigan, and one in the urban district of Cowes.

In addition to the two cases of typhus fever notified in Stepney, it appeared probable, from the circumstances connected with their illness, that three further cases occurred among relatives who lived in the same house with cases notified. This house was

visited by the typhus patient notified from Shoreditch, who, presumably, contracted infection in it.

A small outbreak of typhus fever occurred in the town of Whitehaven in Cumberland in the early part of the present year (1914), and, in view of the comparative rarity of typhus in England at the present day, reference may be made to the facts of the outbreak, as reported by the medical officer of health of that district. There were seven known cases of the disease with one death; and two further deaths occurred under circumstances which suggested that probably they were due to typhus fever.

The first case to be suspected was that of a man "A," who died on 28th February. He had been going about until the previous day, on the evening of which he called for the first time, at the surgery of his doctor for advice. His condition rapidly became worse, and he died within some 60 hours of his first complaining of illness. "B," who was employed to lime-wash the house after the death of "A," contracted typhus and was removed to hospital on 26th March. On the same day "C," who had visited "A" during his illness, died. Although this patient was not notified, the circumstances pointed to typhus as the cause of death. A woman, "D," who assisted in preparing the body of "C" for burial, was subsequently notified as suffering from enteric fever and was removed to hospital. Her case proved to be one of typhus complicated with pneumonia. Three other persons who had been in contact with "D" developed typhus and were removed to hospital on 22nd May. In addition, two other cases of typhus occurred. These were admitted to hospital on 26th March and 24th April. The manner in which they became infected was not elucidated, nor was it ascertained how the disease was introduced into the town.

The past history of Whitehaven in respect to typhus fever is interesting. Exclusive of the cases considered above, there have been, during the past 24 years, no less than 94 cases of the disease in the town with the following distribution as regards time:—62 cases in 1890, 7 in 1892, 1 in 1893, 1 in 1895, 1 in 1896, 1 in 1898, 1 in 1900, and 3 cases of typhus or continued fever in 1901; in 1905 there were 4 cases and in 1906 there were 13 cases.

The occurrence of typhus fever in this country during recent years, as in more remote periods, has nearly always been associated with overcrowding, commonly accompanied by privation.

The manner of introduction of the disease into a district often fails to be elucidated.

The fact that a high proportion of the total cases occurs in or near ports is significant. It is well known that in certain parts of Eastern Europe typhus fever is endemic.

Some of the unexplained cases, especially unexplained cases in inland districts, occur where a considerable proportion of the population is Irish: Ireland until recently was an endemic home of typhus fever on a large scale, and even now a considerable number of deaths from typhus occur annually in that country. In the ten years 1901-10 the average annual number was 68:

in 1911, 37, in 1912, 34, and in 1913, 48 deaths were returned as due to this disease in Ireland. In this country the importance of inquiring into dubious cases, especially into deaths certified to be caused by pneumonia or chronic kidney disease, should not be overlooked.

Occasionally a notification of enteric fever conceals a case of typhus; and cases regarded as enteric fever with anomalous symptoms should be specially observed.

Typhus fever has been described as the common pestilence which accompanies and follows wars, and it would be well, at the present time, that medical officers of health should be on the outlook for its occurrence, more especially as the returns of infectious diseases from abroad indicate that the disease is fairly prevalent in certain parts of Austria, particularly Galicia, and to a less extent in Russia.

ENTERIC FEVER.

This disease, as shown in Fig. 7, has declined to a very satisfactory extent.

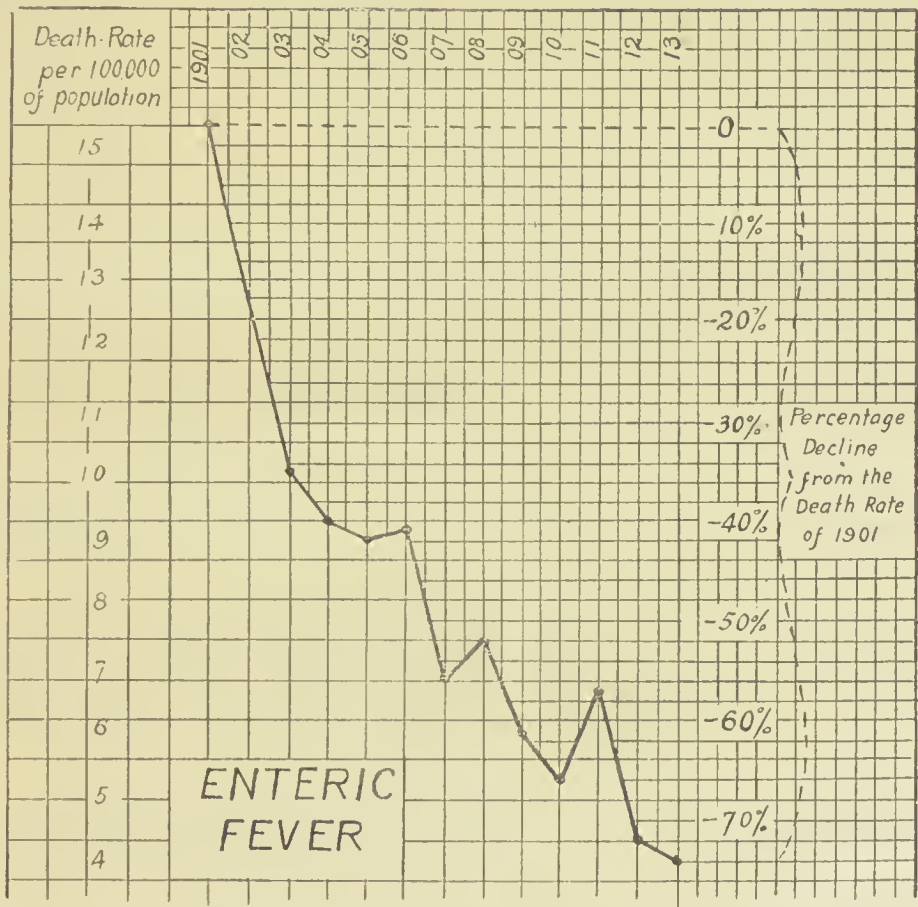


FIG. 7.

England and Wales.—Annual Death-rate from Enteric Fever, 1901-13.

In view of the great sanitary importance of this disease, the following table of its course during a long series of years is given.

Enteric Fever.—Annual Death-rate per 100,000 of population.

—	1871-80.	1881-90.	1891-1900.	1901-10	1911.	1912.	1913.
England and Wales.	33	20	17	9	7	4	4
London ...	24	19	14	7	3	3	2

The sickness-rate from enteric fever during the last three years is shown in the following table.

Enteric Fever.—Sickness Rates per 100,000 of Population.

—	England and Wales.	England.	Wales (including Monmouth)	London.	Aggregate of Administrative Counties of		Aggregate of County Boroughs of	
					England (excluding London).	Wales (including Monmouth).	England	Wales (including Monmouth).
1911	38	38	38	23	39	40	43	26
1912	23	23	21	16	22	20	28	25
1913	22	22	23	17	22	24	25	18

In England and Wales, excluding ports, 8,117 cases of enteric fever were notified, as compared with 8,262 in 1912, and 13,730 in 1911.

In London the highest rates occurred in City of London, 32; Poplar and Stepney, 25. The lowest rates in London occurred in Greenwich, 8, and Camberwell, 9.

In county boroughs the highest rates occurred in Wigan, 108; Canterbury, 61; Devonport, 55; Kingston-upon-Hull, 54; and Portsmouth, 53. The lowest rates in county boroughs occurred in Bath and Bournemouth, 4; Barrow-in-Furness, 5; Southport, 6; Eastbourne, Oxford and Smethwick, 7.

The highest rates for administrative counties as a whole occurred in Lancashire, 50; Northumberland, 47; Monmouth, 40; Durham, 38; and Flint, 35. The lowest rates for administrative counties occurred in Hereford and Montgomery, 4; Rutland and Shropshire, 5; Berkshire and Wiltshire, 6.

During the year three cases of paratyphoid were notified. It is desirable that when the identity of such cases has been ascertained, they should be separately entered in the weekly return to the Board.

In my report for last year (pp. xiv-xx) I referred in some detail to the part which is played by polluted shellfish, drinking water, and milk, and by carrier cases in producing the epidemics of this disease which still occur from time to time in this country and in maintaining its sporadic prevalence.

During the year under review the general incidence of enteric fever in this country has been on about the same relatively low scale as in 1912, and there have been few local epidemics of any magnitude. A small outbreak in the town of Kenilworth, investigated by Dr. Manby, whose report is reproduced in Appendix A, No. 4, furnishes an instructive example of the importance of keeping the purity of public water supplies under observation. Forty-one persons in this town were attacked by this disease between November 22nd and December 25th, 1913, 26 of whom fell ill during one week. The distribution of the cases and other circumstances pointed to the public water supply (furnished by the local waterworks company) as the cause of the outbreak, and when the conditions under which this supply was obtained came to be investigated it was clear that an "adit" from which part of the supply was derived must have received water from a brook fouled by the discharge from a storm overflow of a section of the Kenilworth sewers. This overflow must have come into operation in November, and there was evidence that prior to the outbreak the sewage discharged at the overflow probably contained infective matter derived from a case of enteric fever in a house served by this section of sewers. The "adit," which was in fact little more than a long covered trench parallel to the brook, had for many years furnished a substantial part of the total supply, the rest of which was derived by pumping from deep wells. If at any time a thorough expert investigation had been made of the waterworks, in order to ascertain whether there were physical circumstances which might lead to dangerous pollution, the risks to which the adit water was exposed would not have been likely to be overlooked. This lesson of the outbreak should be taken into serious account by local authorities and waterworks companies. Long immunity from water-borne disease, and the favourable results of occasional water analyses, whether bacteriological or chemical or both, may lead to false impressions of security if local possibilities of contamination have not been sought out and remedied. Special importance now attaches to this matter in view of possible military operations which, besides making an increased demand upon local water supplies, might, in the absence of precautions, expose the sources of those supplies to danger of pollution.

Dr. Manby also reports that some days previous to the outbreak of enteric fever, there was a general prevalence of gastro-enteritis in Kenilworth. It seems probable that this prevalence was also connected with the sewage pollution of the adit water, but the facts available at the date of his inquiries did not enable any certain conclusion on this point to be drawn.

Enteric fever from shell-fish.—During the past year occasional cases and outbreaks of enteric fever, as in past years, were attributed by medical officers of health to the consumption of shell-fish contaminated by sewage. The evidence in most of these instances, especially when only single or a few cases occur, is merely circumstantial; and the causal relation between the shell-fish and the enteric fever is necessarily one of probability of a minor degree. This difficulty in demonstrating the origin of disease is one which commonly occurs in epidemiological investigations when small

outbreaks or single cases of disease are concerned. It is necessary, however, to act in these cases as if the cause had been firmly established; and the wisdom of such action has been shewn, and markedly so in connection with cases and outbreaks of enteric fever attributed to shell-fish *ex post facto*, by the non-recurrence of disease when the action of the supposed agent of infection has been prevented.

During the year, cases of enteric fever occurred in Birmingham among persons who had consumed mussels from Portmadoc; and investigations by the medical officer of health of Birmingham showed that the mussel beds occupied a position dangerously near the main sewage outfall.

Dr. Niven's annual report for Manchester for 1912 contained a special report by Dr. Barbara Cunningham on Enteric Fever and Mussels, giving the results of a careful local inquiry on mussels in relation to enteric fever. An investigation was made concerning 108 cases of enteric fever. In each of these cases mussels had been eaten during the three weeks prior to the onset of the attack of enteric fever; on no occasion had the mussels been cooked sufficiently to kill organisms in their interior; on investigation of the cases no other common factor could be found; and in several instances more than one person was affected who had eaten mussels from the same shop, or from the same wholesale supplier, on the same date.

The following additional facts elicited during the Manchester investigation, supported the conclusion that the mussels probably were responsible for these cases of enteric fever. The proportion of male to female patients was about 2 to 1. In 36 of the 108 cases the patients were beer drinkers to excess, among whom the eating of shell-fish is a common practice. These shell-fish are often purveyed outside the public-house or even in the bar. In 42 instances companions ate mussels along with the patients, and in 13 cases these companions had symptoms of illness either immediately after eating the shell-fish or within a few days.

In Portsmouth during 1912, there were notified 140 cases of enteric fever. This, although a much smaller number than in most previous years, represents a sickness rate from this disease of 0.53 per 1,000 of population, as compared with 0.22 in England and Wales as a whole. Dr. Fraser, the medical officer of health, states:—

I believe that most of the enteric fever in the borough is due to eating shell-fish—oysters, cockles, butterfish, and winkles—which have been contaminated with sewage. I have drawn attention to this danger year by year in my annual and special reports: these warnings have, however, fallen largely upon deaf ears. The collection of shell-fish takes place regularly from places which are obviously sewage polluted, and the shell-fish are disposed of in the borough. It is quite common to see persons picking up shell-fish off the bank near Fort Cumberland, within 100 yards of the outfall of the sewage of the borough, and from other places almost as dangerous. . . . The public are, to a large extent, unable to protect themselves. Once the shell-fish are gathered there is nothing in their appearance to indicate whether they have been collected from a polluted source or not, and provided they are fresh they may appear to be quite wholesome, although loaded with typhoid bacilli.

The protection of the public against the dangers associated with the consumption of contaminated shell-fish will be increased by

regulations under the provisions of the Public Health (Regulations as to Food) Act, 1907, which the Board have under consideration.

MEASLES.

Measles caused 10,453 deaths in England and Wales in 1913, as compared with 12,855 in 1912. In London there were 1,507 deaths from this disease, as compared with 1,828 deaths in 1912. The death-rate for England and Wales for 1913 was 28 per 100,000: for London 34; for the 96 great towns 34; among the 145 small towns 30; and in England and Wales, less the 241 towns, 20.

The reports of medical officers of health indicate a generally lessened mortality from measles in 1913 as compared with preceding years, and although several large outbreaks were reported they were not accompanied by very excessive mortality.

The difficulties met with in carrying out the administrative control of measles have been discussed in detail in previous reports. Local extension to measles of the duty of compulsory notification under the Infectious Disease (Notification) Act, 1889, and such action as has been taken after notification, have not been successful in preventing the spread of the disease. This is owing, in part, to the fact that medical men commonly are not called in to attend cases in the earlier stages of an epidemic, and consequently the disease may have already obtained a considerable hold on the community before cases of it are notified.

Several local authorities during 1912-13 with the consent of the Board have revoked Orders which had been made for the compulsory notification of measles. In some instances the compulsory notification of measles has been adopted during the year. Thus, a young man came to the Bourne urban district apparently suffering from a cold only, and attended a children's party. He developed measles on the following day. This incident was followed by an epidemic of the disease, and led to the district council applying to the Board for permission to make the notification of measles compulsory.

During the year the Devon County Council have passed a resolution requesting the Board to apply the Notification Act to the first case of measles or whooping cough in a household.

The same procedure was advocated by your medical officer in his annual report for 1910-11 (p. xxvii.). It cannot be carried out under the Infectious Disease (Notification) Act, but it would be practicable by means of regulations issued under Section 130 of the Public Health Act.

Under any circumstances the control of measles must continue to be extremely difficult; but combined effort including all the following lines of action promises the greatest measure of success attainable with our present knowledge of the disease.

Similar remarks apply to whooping cough, which is also included in the following suggestions. The notification of measles necessitates also the notification of German measles, owing to the difficulty in distinguishing the two diseases.

1. The duty of notifying measles, German measles, and whooping cough occurring in any given family should

be imposed on the doctor who is called in to attend the patient.

This duty should be subject to the limitation that only the first patient who is attended by him and is suffering from either of these diseases is to be notified; no subsequent case in the same family to be notified during the next two months.

2. The head of every family should have imposed on him or her the duty of notifying to the medical officer of health when he is aware of or has reason to suspect the occurrence of any of the diseases known as measles, German measles, or whooping cough in any member of the family.

In this connection may be mentioned the following clause contained, with minor modifications, in the Manchester, Derby, Liverpool and some other Local Acts:—

Any parent or guardian having personal charge of a child in attendance at a school who is aware of, or has reason to suspect, the occurrence of any of the diseases known as measles, German measles, or whooping cough in any member of the family, and who fails forthwith to notify such occurrence to the head teacher of the school shall be liable to a penalty not exceeding twenty shillings.

3. The head teacher of every school should transmit to the medical officer of health all intimations of these infectious diseases or of suspected cases of these diseases, furnished to him by parents or guardians of children in attendance at the school or by school attendance officers or other persons, except the medical officer of health.
4. It should be the duty of the sanitary authority to arrange for such visits to be made to each house in which a case or suspected case of these diseases has been notified as are necessary to ascertain the nature of the disease, to ensure adequate attendance on the patient and the best available means of isolation.
5. In order that the last-named duty may be fulfilled, each sanitary authority should be empowered to employ such additional medical or nursing assistance as is required with a view to the treatment of persons affected with these diseases and to the prevention of their spread.

The obligation of medical notification of first cases seen by a doctor is proposed, notwithstanding past failures of compulsory notification of all cases of measles and whooping cough, because without it the duty of notification by parents cannot be rendered effective; and in view of the fact that it is now proposed that this notification of first cases seen by doctors shall be made part of an efficient machinery of domiciliary supervision by health visitors, nurses, &c.

The notifications by parents and guardians can only be utilised if there is an efficient machinery for domiciliary visitation. With such machinery there is every reason to expect that the

fatality, if not also the prevalence, of these diseases can be reduced.

In this connection the attention of medical officers of health may once more be drawn to the following extract from the Joint Memorandum on Closure of and Exclusion from School, 1909.

Intimations by School Officers to Medical Officers of Health and School Medical Officers.

13. Under regulations framed as suggested in paragraph 9, or apart from such regulations, the school teacher and school attendance officer should inform both the Medical Officer of Health and the School Medical Officer of any children who have recently been kept at home with illness of a suspicious character, or concerning whom circumstances suggest the possibility of infection. This information probably will have come to the teacher and to the attendance officers from direct communication with parents. In some instances the attendance officers and in others the teachers may obtain the earliest information; and the system of intimations to the medical officers should be so arranged as to secure the simultaneous conveyance to the Medical Officer of Health and to the School Medical Officer of such information. No harm can come from duplication of such notifications, and the Local Education Authority can by careful organisation devise arrangements which shall be prompt and effective and at the same time easy in application.

None of the above proposals is novel in itself. It is doubtful, however, if action on all the suggested lines has been taken in any single sanitary district. It is only by visits, when necessary, for the purposes of diagnosis; and by the giving of advice and of nursing and medical aid as needed, supplemented by hospital provision in selected cases, and especially for the earlier cases in an outbreak, that greater success than has hitherto been secured can be expected.

The adoption of the above co-ordinated scheme presents great possibilities of saving of life, even if the number of cases of measles be not diminished. As is well known, the fatality of measles is largely affected by social circumstances. Thus, in an outbreak in Barnsley in which 56 deaths occurred, 38 of which were from respiratory complications, all the fatal cases were in families living in houses for which the rates were compounded, the fathers in nearly all instances being colliers. The provision of nursing with a certain amount of hospital accommodation for such cases should go far in time towards obliterating the difference in the fatality from this disease in the different classes of society.

As bearing on the importance of nursing, reference may be made to Dr. Thursfield's investigations for the Board, the results of which were included in my last year's report. These drew attention to the frequency of streptococcal infection as the most frequent cause of death in measles by producing broncho-pneumonia and other complications, the probable source of these streptococci being a septic condition of the mouth, fauces, or naso-pharynx. Reports of medical officers of health for 1913 show that this investigation has led to increased attention being given to the cleansing of the mouth and fauces in this disease with good results. In working class households there is, as a rule, little prospect of such treatment being carried out except by or under the supervision of a skilled nurse.

WHOOPIING COUGH.

There were 5,327 deaths from whooping cough in England and Wales in 1913, as compared with 8,407 in 1912. In London there were 767 deaths from this disease. The death-rate for England and Wales was 14 per 100,000; in London 17; for the 96 great towns 17; among the 145 smaller towns 13; and in England and Wales, less the 241 towns, 12.

The steady decline in mortality from this disease referred to in my last annual report continues, and with the exception of the town of Congleton no very severe outbreak of this disease was reported to the Board. At Congleton, population 11,310, 25 deaths from this disease occurred in a few months. All the deaths, with three exceptions, were in children under two years of age, and fifteen were under one year.

Several local authorities have adopted compulsory notification of whooping cough, and the council of the metropolitan borough of Holborn has recently obtained the Board's consent to its compulsory notification for a period of five years from April, 1914. As in measles, the difficulty of ensuring the notification of the earlier cases of whooping cough in the absence of medical attendance is very great, and in consequence a sanitary authority is much hampered in attempting to prevent its spread. The remarks as to the most promising lines of action made under the heading of measles apply also to this disease.

If the *bacillus pertussis* described by Bordet and Gengou be accepted as the cause of whooping cough, it is significant that the expectoration contains very few of these bacilli after the first fourteen days of illness. The complications, such as pneumonia, which subsequently supervene are due to invasion by other bacilli and streptococci. The observation as to the rarity of the specific bacillus in the expectoration after the first fortnight of the attack gives some support to the opinion, held by some as the result of clinical experience, that the disease is not infectious in its later stages. In New York, where arrangements have recently been made for hospital provision for whooping cough, it is proposed to discharge uncomplicated cases from hospital when this period of maximum infectivity is over. In practical experience in this country, whooping cough frequently remains unrecognised during the first ten or fourteen days of the attack.

SMALL-POX.

The number of deaths from small-pox in England and Wales during a series of years has been as follows:—

—			1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.
England and Wales	...	...	760	507	116	21	10	12	21	19	23	8	10
London	...	...	13	25	10	0	0	0	2	0	9	1	0

Of the 90 cases stated in the annual return for 1913 to have been notified in England and Wales, excluding ports, as small-pox, two were found on subsequent inquiry not to have been cases of small-pox. This leaves a net total of 88 cases, as compared with a net total for 1912 of 109 cases.

Of this net total of 88 cases, 48 occurred in towns connected with ports, viz., 1 at Birkenhead, Gravesend, Great Yarmouth, Maldon, Manchester, Southampton and South Shields, 3 at Cardiff and Liverpool, 6 at Kingston-upon-Hull, 7 at Newport (Mon.), and 22 at Newhaven. Of the remaining 40 cases, London had 1, which was at Poplar; 4 occurred in Salford, 8 in Oldham, and 9 in Royton.

In addition, 25 cases as compared with 12 in 1912 and 30 in 1911, were notified to port sanitary authorities, being chiefly imported cases. Of these cases, 11 occurred in Liverpool, 8 in London, 2 in Cardiff, 2 in Weymouth, 1 in Hull and Goole, and 1 in Newport (Mon.) port sanitary districts.

Of the 113 cases, all except three were treated in hospitals, including the hospitals of port sanitary authorities.

During the year 1913 no considerable extension of small-pox took place. Reference was made in my last year's report to a limited outbreak in Newhaven and in neighbouring districts during the early months of 1913. A small outbreak occurred in Oldham, where the first patient to be attacked was a girl who was employed in the cardroom of a cotton spinning mill. The raw cotton used at this mill was of American origin and came either from Texas or Georgia, and the medical officer of health was of opinion that cotton was the source of infection. It may be added that another outbreak of smallpox attributed to infection by means of cotton occurred in the urban district of Milnrow towards the end of May and beginning of June of the present year (1914) and was investigated on behalf of the Board by Dr. Macewen. Eleven persons were attacked, all of whom were employed at the New Ladyhouse cotton mill in that district. As all the patients fell ill within two or three days of one another, a common source of infection had to be sought, and the facts recorded by Dr. Macewen in the report below (Appendix A, No. 6) indicate strongly that the raw cotton handled at the mill was the vehicle of infection. This hypothesis was strengthened by the fact that a man employed at a "waste" cotton mill in Rochdale, which received cotton waste from the new New Ladyhouse mill in Milnrow, also contracted small-pox. This man first handled the "waste" from the Milnrow mill; and the date of onset of his illness and the other attendant circumstances were consistent with the explanation that dust from the cotton which infected the Milnrow operatives was also responsible for his illness.

In Appendix A, No. 1, will be found an analysis of 87 small-pox cases occurring in 1913 in respect of their vaccinal condition, either as recorded at the hospital, and kindly communicated to me by the hospital medical officers, or obtained by the medical officers of health in respect of cases treated at home.

CEREBRO-SPINAL FEVER AND POLIOMYELITIS.

From the 1st September, 1912, these two diseases have been compulsorily notifiable throughout England and Wales.

Fig. 8 shows the number of cases of each of these diseases known to have occurred in England and Wales and in London respectively in each week of 1913. In the diagram the shaded portion

shows the cases notified in urban districts, those notified in rural districts being left unshaded.

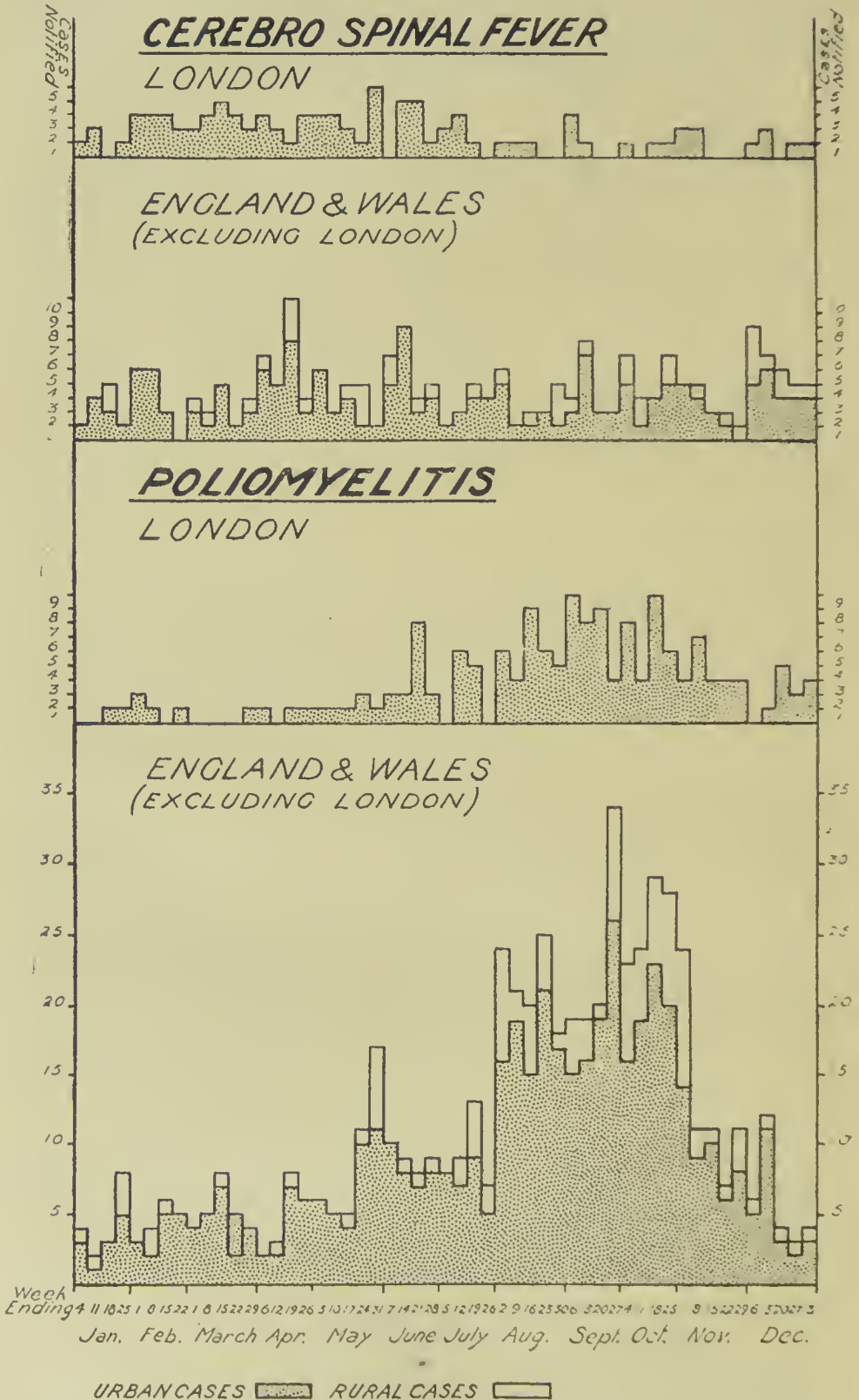


FIG. 8.

Showing the number of cases of Poliomyelitis and of Cerebro-spinal Fever respectively notified in each week of 1913, distinguishing urban and rural cases.

Practically no seasonal curve is visible for cerebro-spinal fever. In London 71 per cent. of the total cases during the year occurred in its first six months, as compared with only 20·4 per cent. of the cases of poliomyelitis in the corresponding period. The seasonal curve of poliomyelitis rises with the advent of the summer months, both in London and in the provinces.

Of the total cases of cerebro-spinal fever 83·5 per cent., and of poliomyelitis 84·2 per cent. were notified in urban districts. In terms of population the attack-rate of poliomyelitis in urban districts approximately is half as great again as in rural districts.

Part of this excess of poliomyelitis in urban districts is explicable by the fact that some cases of this disease from rural districts find their way into urban hospitals before their recognition in the district in which they occurred. In the provinces there is no obligatory provision, such as exists under section 55 of the Public Health (London) Act, for the medical officer of the hospital to send a notification to the medical officer of health of the district from which the patient was admitted.

Dr. Reece has prepared a statement (page 2) giving information in regard to these diseases which can be compared with the similar statement in my last year's report. The fatality rate for poliomyelitis in 1913 was 14·4 per cent. as compared with 13 per cent. in 1912. The fatality rate for cerebro-spinal fever in 1912 and 1913 varied only between 69 and 70 per cent. This apparently high rate of fatality may in part be due to incomplete notification of cases of this disease.

Of the total cases of poliomyelitis 67·1 per cent. occurred at ages under 5, 20·8 per cent. at ages 5-10, 6·1 per cent. at ages 10-15, with lower numbers above these ages.

Inquiries made directly of the medical officers of health for the districts in which cases occurred show that at least 53·5 per cent. of those attacked have recovered with permanent paralysis of one or more groups of muscles; and if to this percentage the fatality rate is added (14·4 per cent.) it will be seen that the disease cripples or kills 70 per cent. of those attacked.

In my last report I indicated the important aid which medical officers of health can render in enabling patients who have suffered from poliomyelitis to become efficient members of society. This can be done by continuing to visit notified cases of this disease at intervals, and by urging upon parents the importance of securing suitable treatment promptly and continuously, and thus minimising the deformities which are likely otherwise to occur.

During the year the Board directed Dr. Macewen to inquire into the circumstances associated with the occurrence of poliomyelitis in Barrow-in-Furness and north-west Lancashire and in Westmorland, and his report* on his investigation is a useful

* Dr. H. A. Macewen's Report to the Local Government Board on the Prevalence of Poliomyelitis in certain Districts of Lancashire and Westmorland, 1913. New Series No. 98.

contribution to the literature of this subject. While he has not succeeded in indicating the exact way in which the infection was carried to those attacked, he has shown that in the part of England under consideration the disease first appeared, though not to a wide extent, in an urban district; that certain cases could be allotted topographically to four groups, and that in these groups there was evidence that the patients or the families of these patients were related to each other in their daily pursuits in such fashion as to allow of infection being communicated from person to person.

Outside this town, cases occurred in a chronological order suggesting that the infection of the disease might have been carried from the town into the surrounding villages and hamlets by persons whose business led them from the town to the country.

Such evidence as Dr. Macewen has been able to obtain lends itself to the suggestion that the virus is in some fashion carried by persons. No evidence could be obtained of the conveyance of the disease by milk or articles of food, or by biting insects, though there was an unduly large number of "flies" during the summer of 1913 in the area over which the inquiry extended. This was specially noticeable in the town of Barrow-in-Furness, where the house refuse is stored in fixed ashpits in close proximity to the houses. The sanitary authority scavenge the house refuse once a week during the summer months, but the type of receptacle in use renders complete cleansing almost impossible.

The possibility of dust acting as a vehicle by which the virus may be conveyed was investigated, but although in one portion of the town dust is much in evidence, it is derived from the slag heaps from steel works and not from the roads.

The greater number of the patients were children. It is a somewhat remarkable fact that at Barrow-in-Furness all the patients were under eight years of age.

There were no multiple attacks in families, and Dr. Macewen gained no evidence of the association of so-called abortive cases with those showing definite paralysis. It has to be remembered, however, that his inquiry took place some time after the outbreak, when minor attacks may have been forgotten.

This particular outbreak illustrates once more the fact that, although this disease is under close scrutiny by many observers in different parts of the world, there are many etiological and epidemiological problems associated with it which still require elucidation.

Much of the investigation required could best be made by the medical practitioner in attendance on the case, and by systematic and painstaking co-operation between him and the local medical officer of health, who will be acquainted with the circumstances associated with other cases in the same district. Detailed reports by medical officers of health on the cases occurring in their districts would materially assist in throwing light on the problems which are now veiled in obscurity.

SECTION V.

TUBERCULOSIS.

A.—*Administrative Control.*

In other parts of this report, pp. cxviii-cxxi, infection from cows' milk on the causation of tuberculosis is made the subject of comment.

For several years past, proposals for additional legislation to control the production, distribution and sale of milk have been under detailed consideration, and since the end of the year to which this report relates the Milk and Dairies Bill has become law. This Act and regulations made under it will enable much more systematic control to be exercised over the share of children's tuberculosis which is due to the consumption of infected milk than has hitherto been practicable in most administrative areas.

So far as infection by tuberculosis from human sources is concerned, Part III. of the Annual Report of the Local Government Board contains a summary of the important administrative work carried out during last year. The present report is concerned mainly with medical considerations bearing on this work, which have arisen during the year, and with the conferences and visits and reports made by medical inspectors. The visits made have been concerned chiefly with general inquiries and local conferences as to the development and administration of schemes for the control of tuberculosis and with inquiries as to sites for hospitals and sanatoria, and as to dispensaries or premises proposed to be used as dispensaries.

The previous year 1912-13 had been marked by the initiation of most important developments in the administrative control of tuberculosis. During that year the Board had completed its gradually extending programme by making all forms of tuberculosis compulsorily notifiable; the provisions of the National Insurance Act, 1911, as to sanatorium benefit came into operation; the capital grant under the Finance Act, 1911, of 1½ millions sterling for the provision of institutions for the treatment of tuberculosis in the United Kingdom became available; and the important offer was made by the Treasury to defray one-half of the annual cost of schemes for the treatment of tuberculosis, proposed by local authorities and approved by the Local Government Board, which are available for the entire population, after deducting any contribution received from the Local Insurance Committee or from other sources.

The year 1913-14 has been concerned with the development of tuberculosis work on the lines indicated by the three governing events set out above.

In carrying out this work, in the medical department, six medical inspectors have been constantly employed, and a large portion of the time of your medical officer has been similarly occupied.

In regard to the working of notification the following points may be noted:—

Public Health Action following Notification.

Attention may be drawn to the general observations on the inter-related duties of the medical officer of health and tuberculosis officer which were made on pages xxxvii-xxxviii of my last annual report. So far as can be judged by last year's experience, notification has been accompanied by less inconvenience and friction than was anticipated. Some of the main difficulties are mentioned below. It should be added that in some areas only imperfect action has been taken after notification, the public health possibilities of notification thus failing to be realised. With the further development of tuberculosis schemes, and as inspection and oversight increase, the public health work which should follow on notification of cases of tuberculosis will doubtless become more uniformly good.

In a few instances, knowledge that an employé was tuberculous is stated to have been followed by dismissal from service. It is not clear that this has been the result of notification: but in dealing with such cases the advice given has been that the medical officer of health or the "officer of the local authority acting under his instructions" (Article XII. of Tuberculosis Regulations) should so carry out his inquiries that the confidential character of the notification is not infringed. In regard to domestic servants, the advice given has been that it will usually be found preferable to arrange for the first interview to be at the office of the medical officer of health or at the tuberculosis dispensary, rather than at the house at which the notified person is employed; or to arrange to take such action as may be needed through the practitioner who notified the case.

In the case of a school teacher, stated to be suffering from open tuberculosis, the aim similarly should be to take action which, besides preventing or minimising risk of infection, is also in the teacher's own interest. This can best be done in consultation with the patient's own doctor, thus securing for the patient the treatment most likely to restore his health and remove his infectivity. Apart from notification it may become the duty of the school medical officer to advise the local education authority that the teacher is not in a fit condition to discharge his duties: and the anticipation of the pension due at a later age in some instances has, I am informed, diminished the hardship of this.

In several instances the question has arisen as to whether the tuberculosis officer has the right to inspect the tuberculosis register. Under ordinary circumstances access to the register should be confined to persons who have duties to perform in connection with the regulations; and in view of the intimate relationship which should exist between the work of the tuberculosis officer and that of the medical officer of health in relation to the visitation of notified cases and the examination of contacts, the tuberculosis officer should have access to the list of notifications.

A number of points have been noted for consideration in connection with possible future modification of the tuberculosis regulations, in the light of our increasing experience of their working.

Visits after Notification.

Reference has been made to the occasional failure to make such visits as may be needed in the interests of public health when cases of pulmonary tuberculosis have been notified. This appears to have arisen, chiefly, through failure of the medical officer of health in these instances to realise that the notification ought to be made the occasion for discovering possibly unnotified cases of tuberculosis in the same house, for ascertaining the patient's previous and present industrial and social environment, and for removing any insanitary conditions that may favour continuance of infection.

Examination of reports of medical officers of health shows that in some areas cases of pulmonary tuberculosis are visited, while cases of non-pulmonary tuberculosis are not visited. This neglect appears to be based on the conception that as non-pulmonary tuberculosis is not very likely to convey infection, no action on the part of the sanitary authority is needed. Failure to visit such cases and to make judicious inquiries implies that a considerable number of unrecognised cases of pulmonary tuberculosis are in this way overlooked. The notification of a case of non-pulmonary as of a case of pulmonary tuberculosis should always be made the occasion of a search for the primary source of infection, which may be a previous case of pulmonary tuberculosis in the same house. In this connection reference may be made to the inquiry on behalf of the Board, the results of which are summarised on page cxx. Out of 98 children between the ages of two and ten years who had died in various hospitals from all causes unselected, 18, or 18·4 per cent. were found to have been infected by tubercle bacilli of the bovine type and 81 or 82·7 per cent. by tubercle bacilli of the human type. These results will need to be supplemented by further series at the same and at other ages, from patients in different geographical areas, as well as by the examination of material from specialised forms of tuberculosis, *e.g.*, of the joints and bones, before a general statement as to the relative importance of infection of human and bovine source can be made. Meanwhile they give a valuable indication of the importance of searching for human sources of infection when a case of non-pulmonary tuberculosis is notified.

Reference may be made also to the question of re-visits to notified patients. The annual reports of medical officers of health appear to show that these are being made with increasing regularity in many areas. Such re-visits are of great importance, as the patient in this way can be brought within the range of any medical or other help which his condition requires, and his perseverance in following the necessary precautions can at the

same time be secured. The re-visits are specially valuable in giving opportunity for impressing the importance of separate sleeping accommodation for the patient with pulmonary disease and for ascertaining whether any contacts are in failing health.

No part of the duty of the staff of a medical officer of health requires greater tact than when the stage is reached of inquiry into the health of contacts. As it is put in the report of the medical officer of health of Chester:

As a rule the visit is received kindly and with interest, but in a few cases the suggestion that any member of the family could be suspected of suffering from tuberculous disease has been resented, and any information refused.

Occasional difficulty has been experienced owing to the fact that the visit following notification may be the first indication to the patient or his friends that the illness is tuberculosis. This thoughtlessness implies unnecessary cruelty to the patient; and is contrary to the interest of the notifying practitioner as well as of the patient. For further remarks on the question of search for the primary or infecting case, see page lxviii.

Examination of Sputum.

In my annual report for 1912-13 (p. lii.) I stated that the bacteriological diagnosis of pulmonary tuberculosis was only practised to a small extent and that this appeared to be due partly to the absence of arrangements for the free examination of sputum in many areas and partly to the neglect of practitioners to avail themselves of the provision in districts where free examination is available.

In a special report on pathological facilities provided by public health authorities published on pp. 214-233 of my last annual report, information was given as to the extent to which facilities for the examination of sputum, in the year 1911, had been provided by these authorities and utilised by practitioners. The following summary was then given:—

The number of specimens of sputum examined officially in county boroughs varied from none in a considerable number, 4, 6, 9, 10, 13, 16 and 20 respectively in 7 county boroughs, to 566 in Brighton, 738 in Bristol, 1,965 in Sheffield, and 2,256 in Manchester. This was equivalent to 309 specimens examined per 100 deaths from pulmonary tuberculosis in Brighton, 167 in Bristol, 350 in Sheffield, and 197 in Manchester.

In London in 22 out of 25 borough councils with an aggregate population of 3,474,522, 2,837 specimens were examined, or 55 specimens per 1,000 deaths. As in the provinces, there are great variations in the supply of facilities for examination of sputa. In three metropolitan boroughs no specimens were officially examined.

After making free allowance for the varying extent to which practitioners examine sputum for themselves or have it examined in private laboratories, there can, I think, be no doubt that this aid to the diagnosis of tuberculosis is greatly neglected in a large portion of the country.

Since that date much progress has been made. Facilities for the free examination of sputum now exist in nearly all

county boroughs and in the majority of the administrative counties: in a large number of the remaining counties and county boroughs arrangements have been made and will become operative with the establishment of a laboratory in connection with the tuberculosis service or otherwise.

The varying extent to which these facilities were utilised during 1913, may be gathered from a recent return obtained through the kindness of medical officers of health. From this return the following examples are taken.

1913.—*Number of specimens of sputum examined on behalf of Public Health Authorities per 100 Deaths from Pulmonary Tuberculosis in each of certain County Boroughs.*

Blackpool	...	...	602	St. Helens	...	...	284
Sheffield	...	...	568	Newcastle-upon-Tyne	...	...	253
Birmingham	...	...	548	Ipswich	...	...	219
Brighton	...	...	439	Nottingham	...	...	210
York	...	...	377	Huddersfield	...	...	203
Hull	...	...	350	Bradford	...	...	178
Lincoln	...	...	341	Portsmouth	...	...	127
Manchester	...	...	334	Halifax	...	...	47
Southampton	...	...	319	Leicester	...	...	45

Insufficiency or inconvenience of official arrangements for the examination of sputum may partially explain the very great differences, shown in the above examples, in the extent to which facilities are utilised. In the main, however, the variations in the above ratios must be regarded as throwing light on the extent to which the tuberculosis officers and medical practitioners in each borough avail themselves of skilled assistance in the diagnosis and treatment of tuberculosis.

Significance of Tubercle Bacilli in Sputum.

As is well known, delay in diagnosing pulmonary tuberculosis until tubercle bacilli can be demonstrated in the sputum often implies unfortunate consequences for the patient: and it is not suggested that primary reliance in the diagnosis of this disease should be placed on the discovery of tubercle bacilli in the sputum. With the general organisation of consultative arrangements under tuberculosis schemes early diagnosis before tubercle bacilli are found in the sputum will become less uncommon than at present. At present the danger is in another direction. A large proportion of cases of pulmonary tuberculosis when notified are suffering from advanced disease. Late notification is due in the main to the patient's delay in obtaining medical advice. In a large number of cases, however, there has been medical delay in recognising the disease. In these instances, recourse to examination of sputum would have ensured much earlier and more satisfactory treatment. In other instances a single negative result from examination of sputum has been accepted as negating the diagnosis of tuberculosis, and the

patient has continued to be treated for bronchitis or some other non-tuberculous disease. These points were emphasised on pages lii-liii of my last annual report, and it is scarcely necessary to discuss them more fully here.

Classification of cases of pulmonary tuberculosis should be based on whether or not, after repeated examination of sputum, tubercle bacilli have been found at any stage of the patient's illness. In the records to be issued by the Board, this will be made the basis of the primary classification of all cases treated in connection with official schemes.

This classification is of importance from the public health standpoint, and for purposes of treatment and of prognosis. A patient showing large numbers of tubercle bacilli in his sputum is more likely than other patients to spread infection; and his treatment in a hospital is desirable unless his family circumstances render infection unlikely. Such hospital treatment is especially desirable if the patient has not previously been trained in a sanatorium. The importance in relation to prognosis of the presence of tubercle bacilli in the sputum is illustrated by facts given by Dr. Forbes in his annual report for Brighton during 1913. In this report he analyses the after-history of sanatorium treated cases four years after leaving the institution. The cases comprised 384 in whose sputum tubercle bacilli were found and 148 in whose sputum it was not found. Of the former, 14 per cent., and of the latter, 55 per cent., were alive at the end of four years. This example confirms experience of other observers who have classified results of treatment on the same basis.

Infectivity of Pulmonary Tuberculosis.

The Royal College of Physicians recently passed the following resolution:

That in view of the exaggerated fear of the infectivity of pulmonary tuberculosis entertained by the public, the consequent unnecessary disabilities imposed upon sufferers from the disease, and the opposition raised in many places to the establishment of institutions for its detection and treatment, a reassuring statement with regard to the degree of danger attaching to contact and communication with tuberculous persons be prepared by the College and issued in its name at an early date.

A Committee was appointed, consisting of Sir Seymour Sharkey, Drs. Habershon, Sandwith, Fremantle, and C. J. Martin, and the report of this Committee, which was approved by the College, is given below. It is inserted here as likely to be useful to medical officers of health. It embodies the chief facts on the strength of which the machinery for the administrative control of tuberculosis, now forming a large part of the work of the medical department of the Board and of medical officers of health, has been initiated.

REPORT ON THE INFECTIVITY OF TUBERCULOSIS.

1. Tuberculosis is an acquired disease, but certain constitutional types may be inherited which render the patient specially susceptible to infection, and there is reason to think that such susceptibility is an inherited character.

2. The infective agent is the tubercle bacillus. This may be contained in the various discharges and excreta of the patient, and especially in the sputum of those suffering from pulmonary tuberculosis. No discharge is infective unless it contains the tubercle bacillus.

3. Cases of tuberculosis of bones, glands, and internal organs from which there is no discharge or which do not furnish any excretion, and cases of arrested pulmonary tuberculosis, have never been proved to be infectious.

(By arrest is here meant that all the symptoms and physical signs of activity have disappeared, and the sputum has either ceased or no longer contains tubercle bacilli.)

4. The means by which tubercle bacilli may enter the body are:

(a) *By inoculation* through a wound or abrasion of the skin. This has occasionally occurred to workers in laboratories, *post-mortem* attendants, and others dealing with tuberculous material, and is presumably the way in which lupus is acquired.

(b) *By inhalation*.—Susceptible animals are readily infected by the inhalation of air containing tubercle bacilli, whether in droplets or suspended as fine dust, but in the spread of the disease among human beings the latter appears to be the more important means of infection. The sputum or other discharges, whether on soiled handkerchiefs, linen, garments, or elsewhere, when dried, may become pulverized, and in this condition may be readily dispersed in the air of a room. That droplets of sputum are less important agents of infection is suggested by the fact that the incidence of consumption upon the staff, nurses, and others engaged in hospitals for the treatment of tuberculous disease, where all discharges are carefully disposed of, is not above the average in the general population.

(c) *By swallowing*. Dust infected by the tubercle bacillus may be conveyed to food and so enter the alimentary canal; or infection may occur more directly in the act of kissing, or by consumptive and healthy persons using the same food utensils. As about 10 per cent. of the milk supplied to large cities contains tubercle bacilli derived from infected cows, this avenue of infection is particularly important in the case of children. The bovine tubercle bacillus is more commonly responsible for tuberculosis in young children than in adults, but the proportion of cases due to it varies very much in different localities.

(d) There is no evidence that tuberculosis can be conveyed to others either by the breath alone, or by emanations from patients, or by their garments, unless soiled by dried sputum or discharges.

5. The spread of tuberculosis is favoured by uncleanness, overcrowding, and imperfect ventilation, and is hindered by the opposite conditions. Experience in hospitals and other institutions where the following precautionary measures have been thoroughly carried out indicates that by such measures the risk of infection is reduced to a minimum, namely:

(a) The careful disposal and disinfection of the sputum and other discharges.

(b) The disinfection or destruction of soiled handkerchiefs, clothes, and linen.

(c) The removal of dust by frequent moist cleansing of the floors, walls, &c., of the rooms.

(d) The supply of abundant air space and free ventilation with fresh air.

No risk is incurred by living in the immediate neighbourhood of institutions for the treatment of tuberculosis which are properly conducted.

Schemes for the Treatment of Tuberculosis.

The particulars as to tuberculosis schemes in different administrative areas are given in the Board's annual report for 1913-14. During last year schemes commenced in previous years have become more fully organised.

The following summary shows the stage at which various schemes had arrived on July 18th, 1914:—

	County Councils (50).		County Boroughs (76).	
	Schemes submitted.	Schemes approved.	Schemes submitted.	Schemes approved.
Fairly complete schemes ...	39	37	60	53
Partial schemes ...	1	1	4	2
Dispensaries only ...	5	6*	6	6*
Total ...	45	44	70	61

* Some complete schemes submitted have been approved in regard to the dispensary unit only.

In no case has a scheme been approved without an organisation for getting into contact with patients, classifying them for appropriate forms of treatment at home or in an institution as required, and supervising them and when necessary securing the continuance of their treatment after discharge from the residential institution. It is only by such an organisation that the full value of beds in a residential institution can be secured.

Tuberculosis Officers.

In nearly all areas the medical officer of health of the county borough or administrative county has been appointed as administrative tuberculosis officer in charge of the organisation of the scheme. One or more clinical tuberculosis officers have been appointed in charge of the clinical side of the work. In a few smaller counties and county boroughs, the medical officer of health has been appointed clinical as well as administrative officer, when there has been satisfactory evidence that he has had special clinical experience in the treatment of tuberculosis. In some instances assistance in the clinical work has been needed, and in some county boroughs an officer who is assistant medical officer of health and assistant tuberculosis officer has been appointed. In other instances, chiefly in sparsely populated counties, officers who have special experience of tuberculosis have been appointed who combine the functions of assistant tuberculosis officer and school medical inspector.

In some instances the county borough council or the county council, or in London the metropolitan borough council, has contracted with a voluntary association or with the committee of a general or special hospital to undertake part or the whole of the dispensary work. The details of the arrangements vary considerably in different cases. In some areas counties and county boroughs have arranged for the appointment of a joint tuberculosis officer, to serve the county borough and an adjacent part of the county area, payment of salary being arranged according to the time devoted to the work of each authority.

The following table shows the progress made in the appointment of clinical tuberculosis officers, London being omitted from the statement:—

—	August 30th, 1913.	April 30th, 1914.	July 18th, 1914.
County councils	63	93	100
County borough councils	45	72	82
Joint committees and joint appointments.	1	4	10
Total	109	169	192

In the appointment of clinical tuberculosis officers the minimum requirements as to age and experience recommended by the Departmental Committee on Tuberculosis or the equivalent of these requirements have been made a condition of approval of the appointment by the Board. In one instance the approval of the Board to the appointment of a medical woman as clinical tuberculosis officer was sought. Approval was given subject to the condition that the services of the medical officer of health would be available if required for special cases.

During the year several applications have been made for approval of the appointment of general practitioners as part-time tuberculosis officers or assistant tuberculosis officers. In very few of these instances has the practitioner in question had the special experience required by the Board and the Insurance Commissioners. Even when this condition is fulfilled, the appointment is open to objection from the standpoint of other practitioners in the area. Friction may arise from the practitioner selected treating the patients of other practitioners. This difficulty does not arise when a part-time tuberculosis officer is also engaged in consulting practice.

At the same time it is very desirable that, in addition to the arrangement for frequent consultation between the tuberculosis officer and the practitioner under the Domiciliary Order for the treatment of tuberculosis, every facility should be afforded to practitioners to attend the practice of dispensaries; and for this purpose their appointment as clinical assistants for limited periods, but not in responsible charge of patients, should be encouraged.

Dispensaries.

During 1913, as in the previous year, tuberculosis dispensaries or centres in most instances have been provided in buildings or parts of buildings, usually dwelling-houses, adapted for the purpose. In other instances a portion of an out-patient department of a general or special hospital has been allocated for the treatment of tuberculosis, at times when it is not in use for other purposes, subject to satisfactory arrangement for cleansing, &c.

Where suitable accommodation could not otherwise be obtained, councils have found it necessary to build dispensaries.

The cost of such provision has varied greatly, being usually higher in county boroughs than in county districts. For the information of medical officers of health of areas similarly circumstanced, the following information may be given.

A satisfactory dispensary is being erected at Chester-le-Street by the Durham County Council at an estimated cost of £500 excluding site and furnishing.

At Wolverhampton a conveniently arranged dispensary on a somewhat different plan is estimated to cost £674.

In Derbyshire several dispensaries are proposed upon a plan which appears likely to prove satisfactory.

At Chinley, buildings are in course of erection to accommodate a tuberculosis dispensary on the ground floor and a school clinic on the first floor; each being approached by separate entrances.

The buildings, which are constructed of permanent material, are estimated to cost about £578, exclusive of site and furniture. Of this cost £360 is allocated for the tuberculosis dispensary and £218 for the school clinic. Similar dispensaries combined with school clinics are proposed at Chesterfield and Ilkeston, but the estimated cost of these is higher than at Chinley.

In many places temporary accommodation is at present in use, pending the provision of permanent dispensaries. In some areas, particularly in country districts, permanent dispensaries cannot be provided until experience has shown where the dispensaries may best be placed to serve the area with due regard to economy in cost of administration and of the time of medical officers and staff. The temporary accommodation provided in some of these instances is unsatisfactory and approval of it has been given for limited periods only.

In selecting premises for permanent dispensaries it is important to give due consideration to (1) convenience of access, (2) freedom from noise, and (3) adequate means of ventilation and prevention of overcrowding. Some existing dispensaries are imperfect in these respects.

Where a county council has proposed to make dispensary provision within a county borough, the desirability of establishing one dispensary to serve both areas has been urged upon each authority. In some of the larger county boroughs the work of the county borough dispensary has been so considerable as to make such a combination impracticable; and after inquiry by a medical inspector, the Board have agreed to the establishment of separate dispensaries for the two authorities. In other instances the authorities concerned have combined to use one dispensary. In some of these cases one authority has provided the dispensary, and either a tuberculosis officer has been appointed to act jointly for the county borough and adjacent county area or the dispensary has been let by the one authority to the other for use on certain days and at certain specified hours.

In other cases the providing authority has leased certain rooms to the renting authority, each authority providing its own tuberculosis officer and staff.

For the information of medical officers of health and tuberculosis officers, the usual conditions imposed by the Board in approv-

ing a dispensary under the National Insurance Act for the treatment of tuberculosis are given here :—

- (a) That the dispensary will be open to inspection at any time by any of the Board's officers or Inspectors;
- (b) That such records will be kept in connection with the dispensary as the Board, after consultation with the Insurance Commissioners, may from time to time require;
- (c) That the Board will be informed of any proposed alteration in or addition to the medical staff of the dispensary;
- (d) That no part of the premises in which the dispensary is situated will be used for the purpose of a clinic for school children without the Board's consent, and that the Board will be informed if it is proposed at any time to use any of the dispensary rooms, or any other rooms in the same premises, for purposes other than in connection with the tuberculosis dispensary; and
- (e) That in the event of the dispensary being discontinued at the premises in question, the Board will be at once informed.

London Dispensary Schemes.

The outstanding feature in the development of metropolitan dispensary schemes during the year has been the willingness of the great general and special hospitals to take part in the work.

Arrangements have been made for dispensaries at, or in connection with, hospitals to serve considerable portions of London. The following hospitals have established, or are shortly proposing to establish, tuberculosis dispensaries :—Brompton Consumption Hospital, Royal Hospital for Diseases of the Chest, City Road, City of London Hospital for Diseases of the Chest, Victoria Park, St. Bartholomew's, St. Thomas's, London, St. Mary's, Middlesex, University College, and Metropolitan Hospitals. Negotiations are also in progress for the establishment of dispensaries at the Royal Free, Great Northern Central, Charing Cross, St. George's, and the West London Hospitals.

Nine voluntary dispensaries and two out-patient hospitals have been included in local schemes and five are negotiating to be included.

Seven municipal dispensaries have been approved and five are at work.

The arrangements for a dispensary service differ considerably in the various metropolitan boroughs. Thus, University College Hospital serves a portion of the borough of St. Pancras, the remainder being served by a voluntary dispensary; in Lambeth part of the borough is served by St. Thomas's Hospital and the remainder by a municipal dispensary. In all cases the Board has insisted upon the dispensary service being adequately co-ordinated with the Public Health Department of the borough.

In London, arrangements have also been made to secure that in difficult cases the wide experience of the medical staffs of hospitals and the superior appliances of these institutions shall be available. Every dispensary which is to form part of a permanent service must be affiliated to a special or general hospital to which patients may be referred by the dispensary medical officer for consultation.

Hospitals which do not propose to establish dispensaries will in some cases carry out consultative work of this kind.

In London, provision of residential accommodation is being provided by the London County Council. This provision will include observation and emergency beds, which should prove of great assistance to the dispensaries. It will be very desirable to arrange for the admission of patients into these beds direct from dispensaries, or otherwise, with as little formality as possible. It is, moreover, desirable that observation and emergency beds should be closely associated with the dispensary, the dispensary medical officer having access to the patients in them. The extent to which these beds are used, and indirectly much of the value of the beds for dispensary work, will depend upon the closeness of their relationship to the dispensary.

Co-ordination of Dispensary Work with that of Local Sanitary Authorities.

In administrative counties, whether the dispensary organisation is provided by the county council or by a voluntary hospital or association, the officers of the dispensary are not officers of the local sanitary authority, and this may involve serious administrative difficulties. The same difficulty may arise in a county borough or a metropolitan borough if the dispensary is provided by a voluntary hospital or association. This difficulty has been experienced in connection with a number of county and metropolitan schemes, and for this reason it is desirable to set out, more explicitly than was done in my last annual report, the public health and medical conditions needing to be met.

Under the Public Health (Tuberculosis) Regulations, the medical officer of health himself, or an officer acting under his instructions, is required to "make such inquiries and take such steps as are necessary or desirable for investigating the source of infection, for preventing the spread of infection, and for removing conditions favourable to infection." The local medical officer of health as a rule will consider it desirable and necessary to visit the home of each notified case either personally or by an officer acting under his instructions in order to investigate possible sources of infection, to give directions with a view to prevent the spread of infection, and to ascertain the existence of sanitary and other defects requiring to be remedied.

Experience shows that the first case to be notified in any family often is not the only or the first case in that family, and the complete inquiry into sources of infection which is needed to prevent the spread of infection implies the need for the examination of all home contacts at the least. But in the majority of districts the medical officer of health has not special knowledge of the clinical diagnosis of early tuberculosis; and it is most desirable that for this purpose he should have the expert assistance of the dispensary medical officer. If all such contacts were willing to attend the dispensary for examination, the necessary co-operation could easily be arranged. Many of them, however, although tuberculous, do not feel ill, and are not

willing to go to a doctor; and in such cases it is important that the medical officer who is to make the examination should be available to visit the house from which the notification has been received.

From the standpoint of the dispensary, if the work of this part of the tuberculosis organisation is being carried on efficiently, there must be a considerable amount of systematic home visiting of patients who attend the dispensary. In a well organised dispensary system, a high proportion of the total notified cases will come under treatment at the dispensary, and be visited at their homes by the dispensary staff. At these visits not only will contacts be examined but advice having direct preventive value will be given to patients and to the families to which they belong. Hence, much of the preventive work which the regulations require to be carried out by the medical officer of health in respect of all notified cases will be partially carried out also in respect of dispensary patients by the tuberculosis officer and his staff.

These considerations show the importance of a thorough working arrangement between the county officers and the officers of the local sanitary authority or between the officers of a voluntary dispensary and of the borough council.

To secure complete co-operation, the dispensary medical officer should be appointed an officer of the sanitary authority at a nominal salary or without salary, to assist the medical officer of health in carrying out work under the regulations. With such an arrangement the special experience both of the dispensary medical officer and of the medical officer of health becomes available for every notified patient. The arrangements will vary locally. In some districts the local medical officer of health or his staff will visit and revisit all notified cases, and will leave the subsequent supervision of dispensary cases to the dispensary officers, or the dispensary cases may be visited only by the dispensary staff from the beginning; in other districts the whole of the visiting of notified cases may be undertaken by the dispensary staff. It is very desirable that the same patient should not be visited and re-visited by two sets of officials, and that in all cases the services of the dispensary medical officer should be available for the examination of all contacts who will submit to examination.

Under the Tuberculosis Regulations notifications made to the local medical officer of health are confidential in character, and he is responsible for maintaining this condition. It is evident, therefore, that the dispensary medical officer when visiting notified patients should act under the instructions of the medical officer of health, as arranged in the Regulations. The lines of procedure in ordinary cases will be settled between the officers concerned; special cases will arise in which the medical officer of health will not consider the ordinary course "desirable," and he will then prescribe the course to be followed. Thus, in the case of a domestic servant notified as suffering from tuberculosis, the medical officer of health may decide that no visit should be made to the house of her employer.

Where local considerations make it necessary to adopt a less complete scheme of co-ordination, the dispensary medical officer will only be able to deal with patients attending the dispensary. Under these conditions notified cases other than those attending the dispensary will be dealt with by the medical officer of health, as the confidential character of the notification precludes the dispensary medical officer from being informed of them, unless he is an officer of the local authority, or is specially authorised. In connection with such a dual system, arrangements should be made to avoid duplication of work and to have the special services of the dispensary medical officer when required.

In a number of counties arrangements on the above general lines have been made. In Worcestershire the tuberculosis officer has been appointed assistant medical officer of health in every sanitary district. During a recent inspection of the arrangements in the county of Durham, Dr. MacNalty found that, as the result of a circular letter sent to the various sanitary authorities by the county medical officer of health, three, possibly four, districts had appointed the tuberculosis officer as assistant medical officer of health without salary for the special purposes set out above, and that the remaining districts with three or four exceptions had agreed to arrangements for co-operation between the tuberculosis officer and medical officer of health. At a later stage it is hoped that other sanitary authorities will appoint the tuberculosis officer definitely as their officer for this purpose.

Observation Beds.

In a few instances observation beds have been provided upon dispensary premises, but usually they are placed in special tuberculosis hospitals or sanatoria or in general hospitals, or in a special tuberculosis pavilion of a suitably arranged isolation hospital.

Our experience of the use of observation beds so far is relatively small, but such experience as has been obtained appears to show that the extent to which the beds will be used depends very largely on the closeness of their functional relation to the dispensary organisation. Although this fact appears to constitute an argument for providing beds at dispensaries, there are practical objections to this arrangement, the chief one being the difficulty of administration in supervising three or four in-patients at a dispensary with due regard to economy.

In some instances observation beds are clinically controlled by the dispensary staff; in some, observation and treatment are carried out by the medical officer of the residential institution in consultation with the dispensary medical officer; and in others, the patients are dealt with independently by the medical officer of the institution. In the interest of sound co-operation in different branches of the work it is very desirable to arrange for the access of the tuberculosis officer to patients sent in by him. Even when the observation beds are provided at a general hospital or in a sanatorium having a medical superintendent with special experience in tuberculosis this arrangement should be maintained. This access of the tuberculosis officer to patients in residential

institutions is further desirable to enable him to advise as to the treatment of patients.

The line between observation and emergency beds is difficult to draw. Patients under treatment at a dispensary may develop febrile attacks or present other indications pointing to a relapse, and will then require at least a short period of treatment in a residential institution as a precautionary measure. They may be regarded as either emergency or observation cases; but the essential point is that there should be no delay in securing their admission to a residential institution. A local scheme can scarcely be regarded as entirely satisfactory which does not comprise arrangements for the prompt admission of such patients to beds for short periods on the recommendation of the tuberculosis officer.

The appended extracts from a report by Dr. Chapman indicate the great value of these beds in connection with dispensary work, and show also the different ways in which they may be utilised (page 68).

The Importance of Early Diagnosis.

The success of a scheme for dealing with tuberculosis depends upon accuracy of diagnosis. Diagnosis of the first recognised case in each household usually depends on the medical practitioner.

If the disease is not recognised at an early stage, curative treatment is liable to fail, and the expenditure on this treatment fails in one of its objects. Furthermore, direct measures for preventing the spread of infection can only be taken from the date when the disease is recognised.

Under the organisation of tuberculosis schemes in this country the work of diagnosis will fall, probably in the majority of total cases, upon the tuberculosis officers; and they are paying increasing attention to this matter as schemes become developed. Medical practitioners by utilising the new organisation will be enabled to make earlier diagnoses for patients coming under their care.

Remarks on the bacteriological examination of sputum have been already made on page lx. It is satisfactory to record that in a number of areas the sputum of all patients under public treatment who expectorate is systematically examined for tubercle bacilli, and if a negative result is obtained the examination is repeated from time to time. Thus, in York, Dr. Chapman, at a recent visit, found that the sputum of every patient coming under public medical treatment is examined as a matter of routine, and if the result is negative further examinations are made at monthly intervals. The records, which had been carefully kept, showed that due importance attached to repeated examinations when no tubercle bacilli were found in the sputum.

Similar good work is being done in other areas, and, in this connection, it is interesting to note that in Sheffield the presence or absence of tubercle bacilli in the sputum is occasionally used as the determining factor in deciding whether a patient with advanced disease shall be treated at home or in hospital.

The probability of a cure being effected is very much greater if the disease is diagnosed before tubercle bacilli commence to be discharged in the sputum. In these early stages, the difficulty of recognising the disease is often, however, very great, and the diagnosis should be undertaken by tuberculosis officers with a wide experience of the disease rather than by general practitioners.

The decision as to whether a patient is actually tuberculous or not is often difficult, there being no general agreement among physicians as to the minimal physical signs and other evidence which may be accepted as indicating the existence of tuberculosis. Some persons, apparently healthy, show physical signs which are occasionally regarded as warranting a diagnosis of tuberculosis, although these persons, if left untreated, fail subsequently to manifest clinical evidence of tuberculosis.

To prevent the continuance of this varying standard of diagnosis, further evidence will need to be collected as to the value and relative importance of the various signs and other evidences upon which diagnoses are now based.

From a practical point of view, the problem with which dispensary officers are concerned is to differentiate between persons presenting evidence of tuberculosis necessitating treatment for cure and other persons who probably will never manifest any clinical evidence of tuberculosis if kept under occasional observation but not treated. For the present, no dividing line can be drawn between these two groups. Until it can be approximately ascertained, it is wise to give patients about whom there is doubt the benefit of the doubt, and to treat them.

A study of the subsequent history of patients presenting minimal evidences of tuberculosis should throw much light on these matters; and it is confidently expected that the records which the Board are about to prescribe will provide much valuable material for investigations into them.

“Following up.”

The preceding remarks have a definite bearing on the patient's welfare as a worker. On the one hand it is undesirable to make the diagnosis of tuberculosis lightly. On the other hand, the many borderland cases concerning which no definite diagnosis can be made either at the dispensary or in observation beds should be asked to report themselves for further examination at a later date. Some system will be required for ascertaining whether they have actually attended and to secure such attendance.

“Following up” is required not only in regard to persons once examined, concerning whom there is doubt as to their freedom from disease and who fail to present themselves for later examination, but also for patients who have been under treatment and neglect to continue it, and for patients who after having been treated have been discharged and fail to report themselves at intervals as directed. It is important to have efficient arrangements for ascertaining these leakages and for making the necessary inquiries.

The method of securing this will vary according to local circumstances; but the following example of an efficient system, which in its exact or in a closely similar form is in operation in several dispensaries, may be placed on record.

When a patient is instructed to attend again at the dispensary his name is noted in a diary under the date upon which he is asked to attend. In some instances a definite time is fixed for the appointment so as to save the patient's time. The names of all patients who attended the dispensary upon the day appointed are ticked off as they are seen, and at the end of the day the names of patients who have failed to attend remain on the list. Letters are then sent reminding these patients of their engagement and making another appointment. If they still fail to attend they are visited by the dispensary nurse or the health visitor. Failure to attend may be due to relapse, and, when this is likely, an early visit of inquiry by the nurse is advantageous.

Examination of a register kept for facilitating work of this kind showed that the majority of the patients followed up attended subsequently, and that in the cases of the remainder non-attendance as a rule was satisfactorily explained.

In areas having, as yet, no adequate system of following up, an appreciable percentage of patients usually cease to attend during the course of treatment at a dispensary, and many are lost sight of after discharge from a sanatorium. The value of the work of a dispensary and of after-care work is materially impaired in the absence of a system of "following up." As schemes develop, more stress will doubtless be generally laid upon this branch of the dispensary's functions.

Examination of Contacts.

In several paragraphs the examination of contacts has been mentioned. It is convenient, however, to summarise here the importance of this branch of tuberculosis work:—

1st: It frequently happens that the first notified case is not the first clinical case of tuberculosis in a given family; and from the standpoint of prevention the detection of such earlier cases is important.

2nd: Examination of contacts frequently discovers patients in an earlier and more curable stage of disease than the notified patient. Until a much higher proportion of total cases of tuberculosis than at present are recognised in this early stage, the number of patients who can be returned as "cured" is not likely to be satisfactory.

All the home contacts of every notified case of tuberculosis should be examined. This should be attempted on the notification of a case of non-pulmonary as well as of a case of pulmonary tuberculosis, as a case of non-pulmonary disease may have been infected by an unrecognised case of pulmonary tuberculosis in the family. So far as practicable, contacts may be asked to attend the dispensary for examination. Many adults, however,

will not trouble to do this, and it is therefore desirable to make arrangements for the examination of all contacts willing to be examined, either at the dispensary or in their own home.

Systematic examination of the household has a greater educational effect on the public and is more efficient in discovering sources of continuing infection than the desultory examination of a few contacts, which in some areas represents the extent of this branch of tuberculosis work.

Inquiries of medical inspectors and the information given in some of the annual reports already received, enable one to give a few examples of the extent to which examination of contacts has been carried in certain large towns. In one of the largest of these towns the number of home contacts averaged 3.75 per notified case of pulmonary tuberculosis. If this average be assumed to apply to the other towns enumerated below, it follows that the percentage proportion of contacts examined in each was as follows:—

Salford, 34; Leicester, 30; Burton-on-Trent, 29; Birkenhead, 29; Bootle, 5 per cent.

It may be added that in Salford 47 per cent. of all the contacts examined were adults, in Burton-on-Trent only 6 per cent.

In another year or two official records will show to what extent this important work is being carried out. In the early stages of development of schemes the whole time available for a limited staff has been spent in general organisation and in dealing with definite and with suspected cases of disease.

Treatment at Dispensaries.

Inspection of the dispensaries in various areas shows that the amount of treatment given at these institutions varies very considerably. In some areas, as in St. Helens, every patient sufficiently well to attend is treated at the dispensary; in other places, especially in some towns in which treatment by tuberculin predominates, treatment at the dispensary is limited almost entirely to that class of patient regarded as likely to benefit more or less from the special method of treatment adopted. In other areas, chiefly in administrative counties, little treatment hitherto has been given at dispensaries, the dispensary work being almost entirely limited to diagnosis and general supervision. The difficulties of treating patients at dispensaries in scattered districts are great, but it is already becoming clear that the success of schemes will depend to a considerable extent upon the degree to which treatment is given at or in connection with dispensaries. Apart from the desirability of giving skilled treatment, the dispensary treatment enables each patient to be kept under supervision, and facilitates arrangements for the examination of contacts. It is somewhat unreasonable to expect patients to attend frequently at a dispensary unless they receive treatment at each attendance. The mental effect of such treatment cannot be safely ignored. In Sheffield during 1913, 54.5 per cent. of the total cases notified during that year were dealt with under the tuberculosis scheme which provides for treatment of all applicants.

In some places there appears to be an impression that dispensary treatment necessarily means treatment by tuberculin. This impression is contrary to the best interest of the patient and of the community. The systematic regulation of the patient's life, his exercise or work, food, &c., and the treatment of special symptoms as they arise, constitute treatment which should not be neglected. It is practised in many dispensaries with excellent results.

Need for Progressive Development of the Work.

In some areas little use has been made of the facilities for diagnosis and treatment provided at the dispensaries. In most of these instances, the deficiency of patients has been due to the fact that treatment is unprovided or provided under inhibitory circumstances.

The following statistics extracted from Dr. Thresh's monthly reports on the tuberculosis work in the county of Essex illustrate the gradual development of work under a complete scheme:—

		1914.					
Dispensary work		1st January.	1st February.	1st March.	1st April.	1st May.	1st June.
Number of patients under treatment:—							
Insured		245	272	279	300	310	324
Uninsured		343	424	488	506	529	573
Total		588	696	767	806	839	897
Number of patients under observation:—							
Insured		128	166	236	275	186	270
Uninsured		203	224	304	242	331	347
Total		331	390	540	517	517	617
Total patients under dispensary treatment and observation.		919	1,086	1,307	1,323	1,356	1,514
Total attendances at the dispensaries by patients.		1,874	1,896	2,250	2,021	2,300	2,085
Number of contacts examined ...		172	165	121	84	76	77
Number of contacts found to be tuberculous.		49	36	32	21	31	16
Number of visits to homes of patients by:—							
Tuberculosis officers		343	263	?	233	246	316
Dispensary nurses		553	490	405	431	539	662

In this instance the steady and rapid increase in the amount of work done by the dispensary service appears to be due to the greater use made of the service by the public, and not to the opening of new dispensaries or to increase in staff. It would

appear also that the increase in patients is largely due to increase of treatment given at the dispensaries. Few contacts have been examined and the number has decreased during the period under review, probably owing to increase in the amount of treatment and consequent curtailment of time available to organise examination of contacts. This imperfection in development may be expected to be remedied shortly.

Domiciliary Treatment.

Under the Board's General Order of July, 1912, as to domiciliary treatment of insured patients the medical officer of each approved dispensary is constituted a consulting officer. It is satisfactory to note, as the result of last year's experience, that in a considerable number of areas the services of this officer are being utilised to an increasing extent by general practitioners. In most instances the patient for whom consultation is needed can attend the dispensary and is sent there by the practitioner for examination. Next year it is hoped that general figures will be available as to the extent to which home consultations between tuberculosis officers and practitioners are taking place.

It is highly desirable when a patient is transferred from institutional to domiciliary treatment, that the practitioner should receive a statement of the condition of the patient and of his previous treatment. This arrangement is important in the interest of the patient, and is helpful in securing the continued co-operation of the practitioner.

For the same reasons, if a patient at the time when he is under the care of a general practitioner attends the dispensary, he should be examined and a report sent to the practitioner.

Dental Treatment.—For many tuberculous patients dental treatment is required, and in a number of areas suitable arrangements for this are being made. It is obvious that, as such treatment is directed against disease which is not tuberculous, complete dental treatment of every patient is impracticable. The policy at present practicable is to remove such conditions as are likely to delay or prevent the patient's satisfactory progress. Until further experience has been gained dental treatment will probably be limited to dealing with conditions associated with oral sepsis, occurring in patients who may reasonably be expected to derive permanent benefit from treatment.

"Care and After-Care."

Of tuberculous patients coming under treatment in connection with tuberculosis schemes some will benefit more or less permanently from treatment and some will benefit temporarily or not at all.

For both these classes of patients care and after-care are often needed beyond what a local authority can give.

A large proportion of the patients treated in sanatoria although greatly improved in health, perhaps even to the extent of complete disappearance of symptoms of disease, are liable to relapse if

placed under unfavourable conditions, either domestic or industrial, after their return home. For such patients the question of supervision and of after-care is most important.

Many other patients need continued care, and owing to increasing poverty, their families, as well as possibly the patients themselves, need assistance calculated to prevent the spread of infection. This may take the form of food, &c., with a view to increasing the resistance of the family to infection, or of means for diminishing infection, as by helping to secure improved housing and especially more bedroom accommodation.

Such care is needed while patients are under domiciliary or dispensary treatment, and after their discharge from a sanatorium. It should be equally available for both insured and non-insured patients. In this respect treatment and care should be guided by the same principles, and for this reason it will be highly desirable for the councils of counties and county boroughs to organise this work.

The following suggestions, based in part on experience of good work already begun in this direction, are made for those proposing to undertake similar work.

It is desirable that each local authority responsible for a tuberculosis scheme should arrange for the appointment of a care committee to secure organised help. In county boroughs one committee will commonly suffice. In counties probably the best arrangement will be to have a central committee and district care committees working with it. To effect the greatest good this committee will need to work in close co-operation with the dispensary organisation of the county council, the latter in like manner being related equally closely with the medical officer of health of each district.

The work of the care committee will be greatly simplified and rendered of higher value by this co-operation. The local medical officer of health can supply valuable information. The dispensary officers possess the records of each patient and are ready to advise the care committee. The dispensary nurses can make any further domiciliary visits that may be needed. The dispensary will also usually have clerical assistance available. In view of the fact that the tuberculosis officer in the course of his routine duties will have ascertained the social and domestic circumstances of each patient, the care committee will usually find it unnecessary to make independent inquiries on these points. Similarly, they will depend on the tuberculosis officer for guidance as to the medical needs of each patient.

The care committee will be able to assist patients to obtain work suitable for their special conditions, to encourage patients to take the precautions and to adopt the recommended treatment, making the giving of assistance conditional on this, and to facilitate such arrangements as may be needed for the welfare of other members of the family.

Among the valuable uses to which voluntary funds may be put are

- (a) The provision of additional food for the family during the absence of the bread-winner in a sanatorium and during the subsequent period of dispensary treatment.

- (b) Instruction in the choice of food and simple lessons in its preparation.
- (c) Assistance with the rent so that the patient may sleep in a separate bedroom.
- (d) Provision of additional bed and bedding and of clothing.

Information as to patients will need to be regarded by the committee as confidential; otherwise much hardship may result to patients.

If the care committee act, as recommended, under the clinical advice of the tuberculosis officer, it will be unnecessary for them to enter into clinical considerations and details respecting any patient.

It is suggested that the care committee should be organised on lines which will fulfil the following desiderata:—

- (1) The county or county borough council as the local authority under the tuberculosis scheme should undertake to organise the care committee, and the officers of the dispensary should be allowed to assist the committee in their work.
- (2) The work of the care committee should relate to insured and non-insured tuberculous patients alike.
- (3) As the main funds of the committee will be derived from voluntary sources, and in order to avoid overlapping of assistance, the committee should have represented on it the chief charitable organisations of the county or county borough. In administering voluntary funds the aid should be independent of consideration of worthiness of the recipients, except in so far as this may affect the possibility of the assistance fulfilling its object.
- (4) In addition, the committee should include the county or county borough medical officer of health and tuberculosis officer as *ex officio* members, and the local medical officer of health and tuberculosis officer similarly on district committees. The committee should include members of the local insurance committee, of the board of guardians, and of the county council or district council. Representatives of the education committee, of any local committees likely to be able to find work for patients, and of the labour exchange, may also usefully be included.

Residential Institutions for the Treatment of Pulmonary Tuberculosis.

The investigation of local schemes by medical inspectors has brought to light much variation in the need for beds in residential institutions in different parts of the country. Some results of our increased knowledge on this point will be more conveniently indicated after stating the present accommodation which is available.

On July 18th, 1914, the number of institutions and of beds which were approved under Section 16 (1) (a) of the National

Insurance Act, 1911, for the treatment of tuberculosis in England, exclusive of Monmouth, was as follows:—

I. Provided by county and county borough councils and other sanitary authorities—		Number of Institutions.	Number of Beds.
Special institutions (sanatoria)	...	20	1,339
Provision at isolation hospitals	...	57	1,493
„ small-pox „	...	30	1,076
		—	—
		107	3,908
II. Provided by voluntary associations and by private enterprise—			
Special institutions (sanatoria and consumption hospitals)	... ..	84	4,059
General hospitals	... ..	35	153*
Children's institutions (voluntary)	...	13	726
		—	—
		132	4,938
		—	—
Total ...	...	229	8,846†
		—	—

In addition to the above, a large number of beds in poor law institutions are employed in the treatment of tuberculosis. Excluding these last-named beds, the accommodation now available in England for the treatment of pulmonary tuberculosis represents one bed for every 3,848 persons (census population).

Further accommodation is in process of being supplied. The Board have approved plans for new buildings to accommodate 2,796 additional patients. These, when provided, will bring up the accommodation in England to one bed for every 2,924 persons. Fifteen sites for new sanatoria and hospitals have been approved. These institutions when completed will supply 1,672 additional beds, and there will then be one bed for every 2,557 of the census population of 1911.

The medical needs met by these beds can most succinctly be described by using the classification of cases of pulmonary tuberculosis set out on page 129. Most of the 4,059 beds in sanatoria and consumption hospitals provided by voluntary associations or by private enterprise are intended for patients in Group A; though, owing to the causes indicated in the paragraph on page lxi, they doubtless contain a considerable proportion of patients in the other groups. It is impossible to state precisely the number of beds available for patients in Group A and in Groups B and C and D respectively; but it is highly probable that the accommodation for patients in Group A has already reached one bed per 5,000 population, the accommodation recommended by the Departmental Committee on Tuberculosis as immediately advisable. This accommodation is at present very

* In 25 hospitals, beds available for the treatment of tuberculosis are not specially allotted; the number of beds given above is therefore less than the number actually available.

† The figures given in my last annual report related to England and Wales. The above figures relate to England only.

unevenly distributed, and much of it is at present being utilised for patients coming within Groups B, C, and D.

The reports of medical inspectors and of medical officers of health, as well as a consideration of the figures given above, show that much more accommodation than is now available is required for patients in Groups B, C and D. In some towns, *e.g.*, in Sheffield and St. Helens, accommodation for these groups of patients has been provided to an extent exceeding one bed to 5,000 population, the tentative standard set by the Departmental Committee. In these towns all insured and many non-insured persons requiring treatment in a residential institution can be adequately dealt with, irrespective of the stage of the disease, but additional beds are needed if patients belonging to the population as a whole, including poor-law patients, are to be satisfactorily treated.

The figures in the table on page lxxix may be compared with the total needs of the community. The Departmental Committee advised that these needs might be assumed to amount to one bed to 2,500 population for all stages of adult pulmonary tuberculosis, in addition to poor law provision. This last in November, 1911, amounted to about 9,000 beds in England and Wales. On this basis the census population of England and Wales implies the need for about 14,428 beds in addition to the 9,000 beds under the poor law, making a total provision of about one bed per 1,500 population.

It is convenient to compare this estimate with the provision or proposed provision in certain areas. On a recent visit, Dr. Chapman found that at St. Helens 52 consumptive patients were receiving residential treatment in the borough sanatorium and 34 patients belonging to the borough were in the poor law infirmary. This present use of beds for pulmonary tuberculosis implies a provision of one bed for every 1,123 persons (census). With this amount of provision, apparently all patients were receiving institutional treatment who needed it. It may be of interest to note that the consumptives under treatment in residential institutions in this borough came within the following groups in each institution:—

				Borough Sanatorium.	Poor Law Infirmary.
Group A	...	..	...	9	2
„ B	...	...	...	26	13
„ C	...	...	...	17	19
				—	—
				52	34
				—	—

Only two county boroughs, Bradford and Sheffield, have, up to the present time, elaborated tuberculosis schemes intended to deal with tuberculosis in all classes of the population, including poor law patients; and the following particulars as to these schemes are important, as a partial guide, to the medical officers of health of other towns.

It should be explained that in each town the number of beds intended to be provided has been decided upon after ascertaining

the number of beds needed to replace existing poor law accommodation *plus* accommodation on the basis of one bed to 2,500 population.

	Bradford.	Sheffield.
Population (1911)	288,458	454,632
Beds to be provided for pulmonary tuberculosis ...	252	350
Representing one bed per population	1,143	1,299

Comparing these different results, it would appear that in many county boroughs something like one bed per 1,200 of population is likely to be needed to meet current requirements for the institutional treatment of pulmonary tuberculosis; but that in administrative counties a smaller number than this may suffice.

In determining the number of beds required in any given area, local circumstances will require to be examined. (1) The chief factor is the incidence of pulmonary tuberculosis, to which at present the death-rate is the most satisfactory guide. (2) The degree of urbanisation of the population is perhaps next in importance. Hospital treatment is found to be much more extensively utilised by town dwellers than by the rural population; and the housing conditions in towns (*see* p. xc) show that this corresponds in large measure with the special needs of urban populations.

Isolation Hospitals.—A considerable portion of the time of the Board's medical inspectors has been occupied during the year in inspecting the arrangements for the treatment of tuberculosis in detached pavilions of various fever hospitals. The amount of this accommodation in England and Wales on October 14th, 1913, was 1,436 beds in 57 fever hospitals; and on July 18th, 1914, in England only it was 1,493 beds in 57 fever hospitals.

From the coming into operation of the National Insurance Act until July 18th, 1914, plans had been approved for new pavilions at 25 fever hospitals, to be used for 435 tuberculous patients. The choice, outside the metropolis, for the treatment of patients in Groups B, C and D, lies usually between the local isolation or fever hospital, and a combined institution for the treatment of tuberculous patients in all the Groups A to D. The latter class of institution presents the advantage of ensuring a residential doctor having special skill in the treatment of tuberculosis; and when the plans are of the general type illustrated in the plans on pages 139-142 of this report, a combined institution suitably situated will enable admirable work to be done.

In many instances, particularly in counties, the balance of convenience may be in favour of the erection of special tuberculosis pavilions at conveniently situated isolation hospitals. The patients thus treated are more accessible to their relatives than the majority of them would be at a combined institution for all stages of tuberculosis—a great advantage, because it renders patients suffering from progressive disease more willing to remain in the institution. A relatively unsatisfactory isolation hospital, possessed by a small sanitary authority, has occa-

sionally been rendered administratively much more satisfactory, when the County Council have arranged to erect a tuberculosis pavilion on the same site.

In areas where there is no isolation hospital it is hoped that the need for providing hospital accommodation for tuberculous patients will stimulate concurrent provision for fever patients. Such a combination tends to economy and efficiency of administration.

If the number of beds for tuberculosis provided at an isolation hospital is below a certain limit, administration becomes unduly costly for these patients. It may be taken as a rough guide that a pavilion for the treatment of fewer than ten tuberculous patients cannot usually be administered with due regard to economy.

Arrangements have been made in a few instances for the treatment of consumptives belonging to all the Groups A to D in separate pavilions attached to isolation hospitals. These have been hospitals in which adequate land has been available for outdoor exercise, &c. It has also been considered important that there should be a resident medical officer at these hospitals and that he should have special experience in the treatment of tuberculosis.

Small-Pox Hospitals.—The strict conditions under which the use of these hospitals is sanctioned for the treatment of tuberculosis were stated in my last report. On October 14th, 1913, 31 small-pox hospitals providing accommodation for 953 patients were approved. In the following July the number of hospitals was thirty, and of beds 1,076.

In only a few areas will some part of the permanent accommodation for the treatment of tuberculosis be provided at small-pox hospitals. It is evident that, otherwise, tuberculosis work would be seriously crippled when small-pox became epidemic. To minimise this drawback, the Board in one such case have required that a certain number of beds for patients in Group A should be retained in a special sanatorium. It should be added that the arrangements in a small-pox hospital are necessarily more suitable for the treatment of an acute than of a chronic disease; and that the cost of treating tuberculosis in a small-pox hospital is usually high owing to the wards being unnecessarily large and the loan charges heavy.

In some counties negotiations have been in progress for "pooling" small-pox hospitals within the administrative county, and adapting some of them for the treatment of tuberculosis. With modern facilities of communication by means of motor ambulances, this is both practicable and economical. It is likely that some of the small-pox hospitals now in use will only be employed for the treatment of tuberculosis until more permanent provision is made.

General and Special Hospitals.—These hospitals, especially in London, have shown their willingness to join in schemes for the treatment of tuberculosis, by providing beds for special classes of patients. Experience shows that general hospitals are well fitted to deal with the following classes of patients. The list is

arranged in the order in which these hospitals will be most likely to be helpful. The first five groups consist of pulmonary cases.

- (1) Patients admitted for observation, with a view to diagnosis;
- (2) Patients admitted to ascertain the form of treatment best adapted for the patient's needs;
- (3) Emergency cases, *e.g.*, haemoptysis;
- (4) Patients requiring surgical aid for intercurrent disease;
- (5) Patients with advanced disease admitted for special purposes;
- (6) Patients with non-pulmonary tuberculosis, requiring surgical or special treatment.

For the convenience of medical officers of health and others, the usual conditions which the Board prescribes in approving the use of a general hospital for the treatment of tuberculosis are given here:

- (a) That the hospital will be open to inspection at any time by any of the Board's officers or inspectors;
- (b) That such records will be kept in connection with the hospital as the Board, after consultation with the Insurance Commissioners, may from time to time require; and
- (c) That patients admitted for the treatment of pulmonary tuberculosis shall not be received into general wards of the hospital in which persons suffering from other diseases than tuberculosis are treated.

With regard to condition (c), it is not intended to preclude the admission into the general wards for a short period of cases of pulmonary tuberculosis requiring urgent operative treatment, or of patients who on account of such an emergency as haemoptysis require to be received temporarily into the hospital, or of patients sent to the hospital for observation, with a view to diagnosis, who have no expectoration or only a small amount of expectoration which, on repeated examination, has been found to be free from tubercle bacilli.

Hospital committees in some instances have hesitated to accept the conditions of approval; to meet this difficulty conferences have been held at the Board's offices, or a medical inspector has visited the hospital to explain the conditions.

The right of inspection has formed a not infrequent stumbling block, interference with the management of the hospital or with the treatment of patients being feared. Usually this fear has disappeared on explanation that no interference was intended, but that it was necessary for the Board in administering public monies, to have first hand information that the general arrangements are satisfactory. It has also been pointed out that there was no wish to interfere with varied methods of treatment coming within the range of medical knowledge and practice.

So far the Board have not prescribed records to be kept at approved institutions for the treatment of tuberculosis. Any records that may hereafter be required will not involve an undue amount of work; but such records at every stage of treatment are necessary in the interests of the patient, to enable continuity of treatment to be made possible for him.

In a few instances objection has been taken to the condition that patients with pulmonary tuberculosis shall not be received into general wards of the hospital in which persons suffering from

diseases other than tuberculosis are treated. There is, however, a fairly general consensus of medical authority in favour of the conclusion that it is inadvisable and may be dangerous to treat patients with pulmonary tuberculosis in the same ward as patients who are suffering from other diseases or who are in a weakly convalescent condition after these diseases. It is agreed, however, that exceptions to this rule may be made for the treatment for a short period of emergency cases, *e.g.*, hæmoptysis, and of patients needing surgical aid for inter-current disease.

By the co-operation of general hospitals in schemes for treating tuberculosis the highly experienced staff and the equipment of these hospitals become available under official schemes. The hospital will become the natural centre for the diagnosis of specially difficult cases, for special forms of treatment for both surgical and medical cases, and, owing to its geographical position, for the treatment of emergency cases. It is not likely, however, that the general hospital will be generally utilised for the treatment of uncomplicated cases belonging to Group A, which can be more advantageously treated in the country.

Nearly all the consumption hospitals throughout England have received formal approval, and will, it is expected, form part of permanent schemes.

Sanatoria and Combined Institutions.

On July 18th, 1914, there were 104 approved sanatoria and special consumption hospitals containing 5,398 beds, of which 20 institutions containing 1,339 beds, or 25 per cent. of the total accommodation, had been provided by local authorities.

The Board declined to continue to approve five institutions, containing 76 beds, owing to failure to comply with the Board's requirements.

In a number of other cases the owners or committees of management were informed that the institutions were not regarded as suitable for inclusion in permanent schemes. This was usually due to the character of the buildings and to unsatisfactory administrative arrangements. As the result of visits by inspectors, considerable improvements have already been secured in the general arrangements and administration of a number of sanatoria. In one or two instances inspection showed that the institution had been altered so as to accommodate additional patients. Evidently increased accommodation for patients might be provided at the expense of efficiency, and the character of the institution might even be changed. For these reasons the Board have made the additional condition in approving residential institutions, excepting general and special hospitals:

That no alteration of the existing accommodation at the institution for patients or staff, or provision of additional accommodation will be made until full particulars of the proposals, together with any necessary plans, have been submitted to the Board and their approval has been given.

This condition relates only to alterations to the accommodation for patients or staff and is not concerned with such items as the erection of a water tower or the installation of electric light.

During 1913, an increasing number of county and county borough councils have provided their own residential institutions. In smaller county boroughs and a few of the smaller counties where attempts to secure combined arrangements with other authorities have failed, it has been found necessary to provide one combined institution for the treatment of patients with pulmonary tuberculosis in Groups A, B, C, and D (page 129), instead of a separate sanatorium and hospital.

In larger towns the tendency has also been definitely in favour of combined institutions. In many county areas the desirability of providing hospital accommodation near the patients' homes has led to the erection of special pavilions at isolation hospitals. This has, however, not always been practicable; and in such cases, or apart from this, a central institution fairly convenient of access for relatives has been arranged.

Duration of Treatment in Residential Institutions.

Schemes for the treatment of tuberculosis in most areas have not been established for a sufficient period to enable safe inferences to be drawn as to duration and methods of treatment. Subject to this necessary limitation, it is useful to note that in residential institutions for administrative counties the average duration of residential treatment per patient during 1913 was 74·6 days, and for county boroughs it was 77·8 days. These averages apply in different areas to very varying proportions of early and of more advanced cases. At present it is impracticable to ascertain the duration of treatment of patients in each of the Groups A to D separately.

In some towns, as in Leicester, a short period of treatment and education in a residential institution is followed by a relatively prolonged treatment at the dispensary. In other towns protracted sanatorium treatment is given to some of the cases: and there are towns in which both methods are employed, according to the special needs of patients.

The observations of medical inspectors tend to show that prolonged sanatorium treatment is sometimes given to patients who are not likely to derive more than very temporary benefit from it; while, in other instances, sanatorium treatment is discontinued too early.

Reference should be made to the paragraph on observation beds on page lxx, and to Dr. Chapman's report on this subject on page 68.

Construction of Sanatoria.

In February, 1913, a memorandum was issued by the Board signed by the Board's architect and medical officer giving suggestions and plans for the rapid provision of inexpensive sanatorium accommodation. Pavilions erected on the general lines recommended in this memorandum have been erected at St. Helens, Eastbourne, and some other places.

In February, 1914, a further memorandum was issued with a view to afford local authorities and others further assistance in

the provision of special residential institutions in connection with permanent schemes for the treatment of pulmonary tuberculosis. This memorandum is set out in Appendix A, p. 128.

Hospital Provision for Disease in General.

During the last few decades an increasing proportion of the total cases of pulmonary tuberculosis has been treated in poor-law and other hospitals, especially of those patients who are bed-ridden, and of those suffering from advanced disease. This steady increase in the hospital treatment of tuberculosis has formed part of a humanitarian impulse, which has led both private charity and publicly organised government to provide more suitable facilities for the treatment of serious diseases than is practicable in the vast majority of dwellings, especially under urban conditions of life. The Board are obtaining a detailed return as regards hospital accommodation in each county and county borough area. During the year under review it became necessary for me to obtain a rough estimate of the number of hospital beds of various kinds, and so far as can be stated on the strength of unofficial information it would appear that there were recently in England and Wales—

358 General hospitals	...	with 29,508 beds
228 Cottage hospitals	...	„ 2,903 „
10 Lying-in hospitals	...	„ 343 „
19 Women's hospitals	...	„ 721 „
12 Hospitals for women and children	... ..	„ 739 „
54 Children's hospitals	...	„ 5,805 „
60 Tuberculosis hospitals	...	„ 4,211 „
14 Ear and throat hospitals	...	„ 312 „
28 Eye hospitals	... ..	„ 1,219 „
8 Dental hospitals	...	„ — „
33 Hospitals for incurables	...	„ 1,605 „
601 Hospitals for infectious diseases	... ..	„ 23,703 „
143 Small-pox hospitals	...	„ 4,402 „
109 Asylums for the insane	...	„ 109,024 „
14 Institutions for the feeble-minded	... ..	„ 11,559 „
241 Convalescent institutions	...	„ 14,995 „
37 Miscellaneous hospitals	...	„ 3,020 „
264 Dispensaries	... ..	„ — „

Altogether, excluding poor law infirmaries, there were in England and Wales in 1913 approximately 2,233 hospitals and other institutions providing treatment for the sick, having 214,069 beds, or one bed per 168 of the population. Of this number the 28,105 beds for infectious diseases and small-pox, the 109,024 beds in lunatic asylums, the 11,559 beds in institutions for the feeble minded, and an uncertain proportion of the beds at consumption hospitals are provided by local authorities.

The extent to which this hospital accommodation has increased since 1870 is indicated by the figures given by the Registrar-

General as to the proportion of total deaths occurring in workhouses (including workhouse infirmaries), hospitals (general and special) and lunatic asylums. These are set out graphically in Fig. 9.

*Per cent. of
total deaths
occurring in
Institutions.*

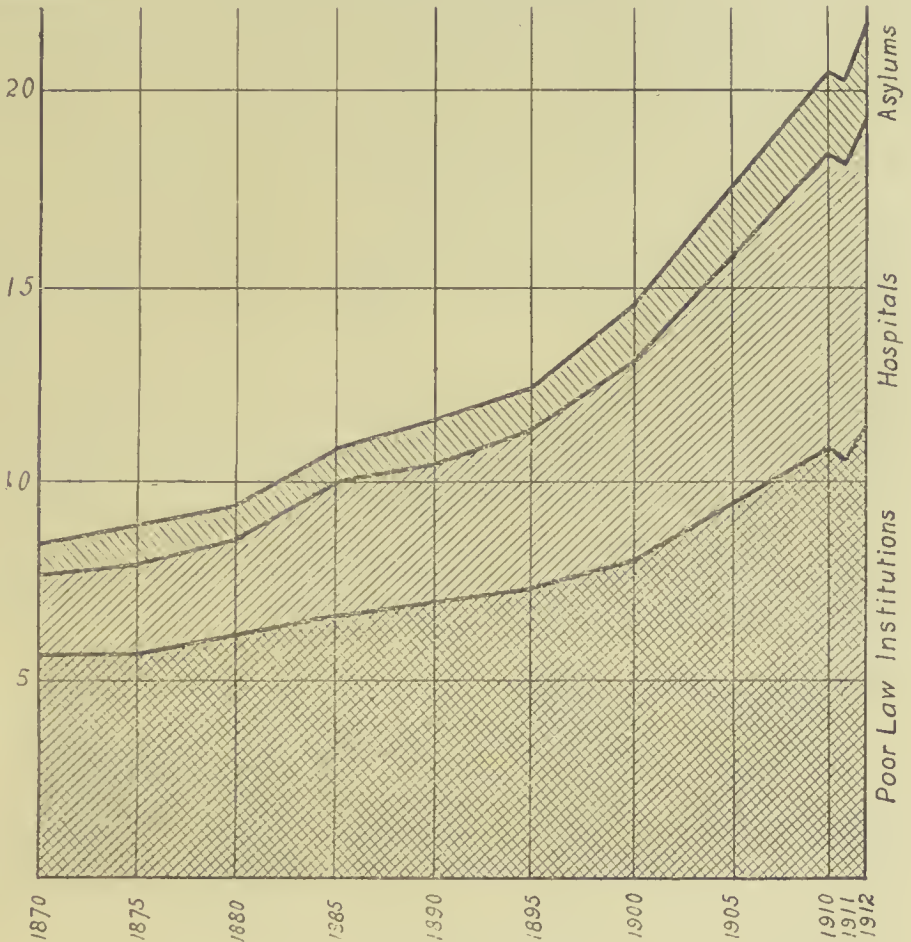


Fig. 9.

England and Wales 1870-1912.—Proportion of Deaths from all causes occurring (a) in Poor-law Institutions, (b) in Hospitals, (c) in Lunatic Asylums.

In 1870, 5.6 per cent. and in 1912, 11.3 per cent. of the total deaths in England and Wales took place in workhouses and their infirmaries; in hospitals in the same period the increase was from 2.0 to 8.0 per cent., and in lunatic asylums 0.7 to 2.3 per cent.

These figures represent an immense change in the conditions under which disease is treated in this country; and in setting out the influences which have brought about the reduction in the death-rate from a large number of diseases, an important place must be given to the improved treatment of disease which is now secured in our medical institutions for a largely increased proportion of the total population.

The Hospital Treatment of Tuberculosis.

The facts as regards the institutional treatment of tuberculosis are even more remarkable than those for disease in general.

During the year 1912 of all the deaths occurring respectively from pulmonary and from non-pulmonary tuberculosis, the proportion occurring in hospitals was as follows:—

Percentage of Total Deaths from each cause in Workhouses and Hospitals in the Year 1912.

	Pulmonary Tuberculosis.		Non-Pulmonary Tuberculosis.	
	Male.	Female.	Male.	Female.
London	56·5	43·8	58·2	50·4
County Boroughs...	35·1	21·7	28·4	23·7
Other Urban Districts	19·6	12·0	18·5	17·1
Rural Districts ...	11·4	6·4	14·2	11·6
England and Wales	31·1	19·1	26·4	22·4

It is interesting to note the administrative areas affected by various degrees of hospital treatment of pulmonary tuberculosis, and the aggregate populations thus affected, so far as this can be gauged by proportion of the total deaths from pulmonary tuberculosis occurring in hospitals. The results for the year 1912 are summarised in the following table:—

England and Wales, 1912.—Proportion of Total Population in each Group having Different Percentages of Institutional Treatment of Cases of Fatal Pulmonary Tuberculosis.

Total percentages of Deaths from Pulmonary Tuberculosis occurring in institutions.				Administrative Counties.	County Boroughs.	Metropolitan Boroughs.
0-10 per cent.	...	...		7·9	—	—
10-20 "	...	...		58·2	13·1	—
20-30 "	...	...		28·2	31·1	—
30-40 "	...	...		5·7	34·6	3·7
40-50 "	...	...		—	14·6	13·0
50-60 "	...	...		—	6·6	56·9
60-70 "	...	...		—	—	20·4
70-80 "	...	...		—	—	6·0
				100·0	100·0	100·0
Total population	...	...		20,655,948	11,363,934	4,519,754

Both of the preceding tables show that the county boroughs, and still more London, provide hospital, including infirmary, treatment for tuberculosis to a much larger extent than other parts of England and Wales. It is a striking fact that in London more than half of the total deaths from tuberculosis occur in hospitals, under conditions in which greater comfort and help to

the patients are doubtless secured than would be possible under the domestic circumstances of the majority of these patients. The relief of anxiety, the diminution of infection, the lessening of financial stress in respect of the thousands of families involved in these facts must also be very great.

In county boroughs between a fourth and a third of the total deaths from tuberculosis occur in hospitals, in other urban districts nearly a fifth, and even in rural districts about one-tenth.

The second of the above tables shows the proportion of the population affected by different degrees of hospital treatment of tuberculosis, so far as this can be measured by deaths in these institutions. It will be seen that in metropolitan boroughs representing 6 per cent. of the total population of London, 70-86 per cent. of the deaths from pulmonary tuberculosis occur in hospitals and infirmaries, that in metropolitan boroughs representing 20·4 per cent. of the population of London 60-70 per cent. of such deaths occurred, and so on. The corresponding ratios for county boroughs and for administrative counties are set out in the table.

Proportion between Poor Law and other Hospital Accommodation for Tuberculosis.—The statement of number of beds given on pages lxxix-lxxx, gives some indication of this proportion. A further indication is given by the following table:—

England and Wales, 1912.—Proportion per cent. of Total Deaths from Pulmonary Tuberculosis occurring in (a) Total Institutions (Hospitals, Asylums, and Infirmaries), and (b) Workhouse Infirmaries.

		Total Institutions.	Workhouse Infirmaries.
Administrative Counties	...	17·9	10·0
County Boroughs	...	33·0	25·1
Metropolitan Boroughs	...	56·3	41·2

Thus in 1912, of the total deaths from pulmonary tuberculosis occurring in institutions, 56 per cent. occurred in poor-law institutions in the administrative counties, 76 per cent. in the county boroughs, and 73 per cent. in the metropolis.

From information kindly supplied by Dr. Scurfield the following information as to Sheffield is derived.

Deaths from Pulmonary Tuberculosis in Institutions in Sheffield, 1911-13.—Per cent. of total deaths from this disease.

—	1911.	1912.	1913.
Poor Law Infirmaries	34·4	35·7	25·5
Other Hospitals	3·6	4·1	13·7

The process of transfer of the institutional treatment of tuberculosis from poor-law institutions under a complete scheme for the treatment of this disease is seen in the table.

Incidentally the greater recourse to institutions of men than of women when affected with pulmonary tuberculosis about to be

fatal is shown in the Sheffield figures, the male percentages of total deaths occurring in public institutions in the three years 1911-13 being 28·0, 31·6, and 27·7, and the female percentages 10·0, 8·2, and 11·5 in the same years. This is in accord with the experience of other towns.

Housing in relation to the Hospital Treatment of Disease.

The increased resort of the sick to hospitals is an expression of a number of factors. It represents a greatly increased ability and willingness on the part of the community to bear, either by way of voluntary subscriptions or through rates and taxes, the heavy expenditure involved in the increased hospital provision. It means also a great awakening of the public conscience to the needs of the sick, and a determination to secure for them satisfactory medical attendance and nursing. It is largely also the resultant of social forces, in which industrial stress and the difficulties of urban housing play a predominant part. Were it not for the present amount of hospital treatment available in most of our large towns, the results of the cramped housing of wage-earners would be much more serious than are now shown. Life in its multifarious aspects in a one, a two, or a three-roomed tenement becomes more difficult and unsatisfactory when an additional birth, and still more when serious sickness, occurs. The census figures for 1911 as to housing give some clue to the extent to which hospitals relieve the situation.

At the census of 1911, in England and Wales, out of every 13 families one lived in a tenement comprising one or two rooms, and out of every five families one lived in a tenement consisting of not more than three rooms. In urban districts the room accommodation per family is much less satisfactory than in rural districts. This is shown by the following tables taken from the 1911 census reports, comparing the aggregate experiences of urban and rural districts in England and Wales.

Census, 1911.—Percentage of the Total Population living in Tenements of different sizes.

	Number of rooms.				
	1.	2.	3.	4.	5 and over.
Aggregate of urban districts ...	1·7	6·5	12·7	23·1	56·0
" " rural " ...	0·2	3·5	10·8	25·5	60·0

Thus, over eight times as many of the urban as of the rural population live in one-roomed tenements, and nearly twice as many of the urban as of the rural population live in two-roomed tenements.

The following table shows the relative prevalence of overcrowding in the two groups—a room with more than two occupants being regarded as overcrowded.

Census, 1911.—Percentage of the Total Population living in Tenements of various sizes with more than two occupants per room.

	Number of rooms.				
	1.	2.	3.	4.	5 and over.
Aggregate of urban districts ...	0·7	2·5	3·0	2·2	0·9
„ „ rural „ ...	0·1	1·2	2·2	2·1	0·7

The amount of overcrowding is seven times as great in urban as in rural one-roomed tenements and twice as high in urban as in rural two-roomed tenements. Combining the results of the two tables it will be seen that in urban districts there is a much larger proportion than in rural districts of tenements too small to make decent family life easy, and that these are much more crowded than tenements with the same number of rooms in rural districts.

These facts have much significance in relation to the greater use of hospitals in urban than in rural districts. There can be no reasonable doubt that, were it not for this greater use of hospitals in urban districts, the excess in their death-rate over that of rural districts would be much higher than at present.

B.—THE STATISTICS OF TUBERCULOSIS.

During 1912, the most recent year for which complete figures are available, 38,083 persons died in England and Wales from pulmonary tuberculosis as compared with 39,232 in the year 1911; and 11,968 from non-pulmonary forms of tuberculosis as compared with 13,888 in the year 1911.

The course of the death-rate from pulmonary and from other tuberculoses for males and females and for persons since 1901 is shown in the table below* for which I am indebted to the courtesy

^o *England and Wales.—Phthisis and Other Tuberculoses : Standardised Death-rates per Million living, 1901-1912.*

	Phthisis.			Other Tuberculoses.		
	Males.	Females.	Persons.	Males.	Females.	Persons.
1901	1,486	1,054	1,263	598	492	543
1902	1,450	1,022	1,229	551	472	510
1903	1,416	990	1,196	592	502	545
1904	1,443	1,027	1,228	603	504	552
1905	1,329	944	1,130	543	467	504
1906	1,334	955	1,138	541	479	509
1907	1,315	948	1,125	520	444	481
1908	1,282	928	1,099	530	445	486
1909	1,238	900	1,063	499	425	461
1910	1,145	841	988	474	397	434
1911	1,210	910	1,055	430	372	400
1912	1,170	860	1,010	366	317	341

Deaths from Acute Miliary Tuberculosis are included under Other Tuberculoses for the years 1901-10, but under Phthisis in the years 1911 and 1912. The Standardised Death-rate from Acute Miliary Tuberculosis in 1911 was 23 per million persons living, being also 23 per million in each sex.

of the Registrar-General's department. The rates given in this table are standardised rates, having been corrected in respect of variations in age and sex constitution.

From 1911 onwards the deaths from pulmonary tuberculosis and from other tuberculoses are given for each administrative area in the annual reports of the Registrar-General, and it becomes possible therefore to institute accurate comparisons between the statistics of these areas. For administrative counties and for county and metropolitan boroughs, death-rates are also given. These are crude death-rates, but they can be standardised and thus made strictly comparable with the standardised death-rates for England and Wales, by utilising the factors of correction given on page 240 of my annual report for 1912-13. In the present annual report (p. 150) are given some alterations of factors of correction rendered necessary by changes in administrative areas.

Age and Sex Distribution of Death-rate.—In 1911 the standardised death-rate from pulmonary tuberculosis in England and Wales for both sexes was 1·06 per 1,000 and in 1912 was 1·01. in 1911 being 25 per cent. lower and in 1912 26 per cent. lower for females than for males. The difference between the death-rate in the two sexes for different divisions of the country is shown in the following table:—

Pulmonary Tuberculosis.—*The Death-rate from Phthisis among females was lower than that among males to the extent of—*

	1911.	1912.
	Per cent.	Per cent.
London	42	45
Aggregate county boroughs	30	33
Aggregate of all other urban districts	21	21
Aggregate of all rural districts ...	3	1
	—	—
England and Wales	25	26
	—	—

The death-rate from pulmonary tuberculosis varies greatly according to age as well as sex. In 1912 it was at its maximum in males at the age-period 45-50, amounting to 2·30 per 1,000 living at this age, and almost the same in the next ten years of life. Among females in the same year the highest death-rate was 1·35 at the age-period 35-40, the death-rate from 25-35 and from 40-50 not being much lower than this figure.

The Registrar-General's report for 1912 contains valuable information as to the distribution of the death-rate from pulmonary tuberculosis at different ages in each sex. From his tables, Fig. 10 has been prepared.

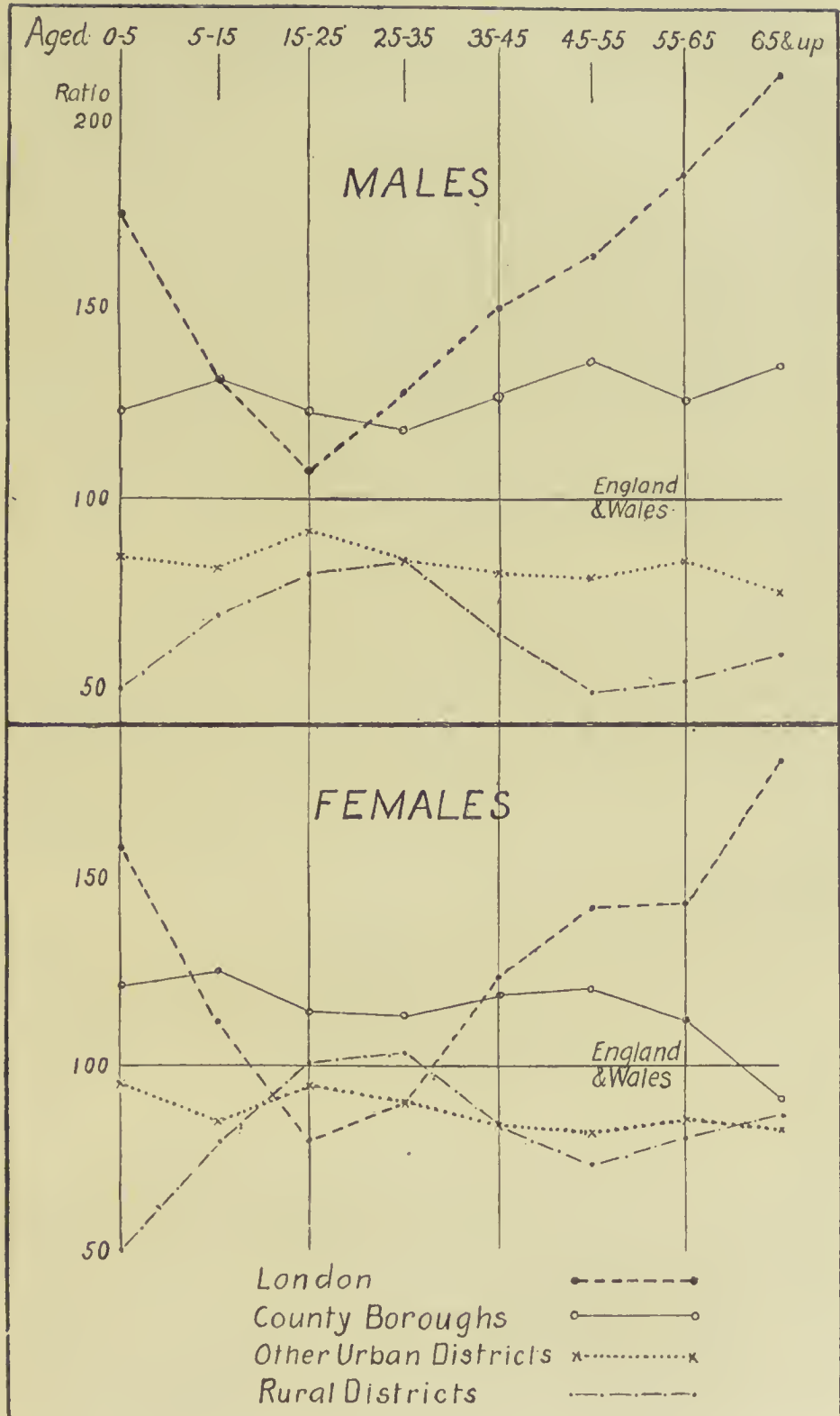


Fig. 10.

Ratio of the Death-rate from Pulmonary Tuberculosis for each age-period in the two sexes to that of England and Wales at the same age-period. (England and Wales at each age-period = 100.)

For each sex the death-rate at each age-period 0-5, 5-15, 15-25, &c., &c., for the whole country is taken as 100, and the deviation from this average is shown in each division of the country. The curves for *males* show in London and in the county boroughs a death-rate which at all ages is well above the average rate for the whole country. In the county boroughs as a whole the death-rate remains at a fairly uniform level above the average rate. In London, the excess over the average is markedly lowered at ages 5-35, and especially at ages 15-25, possibly due to immigration of healthy lives; while at ages over 35 the death-rate in London is higher to a progressively increased extent with advancing age than in the rest of the country. The death-rate is lower in the aggregate urban districts than in the county boroughs; and is lower still in the aggregate rural districts. The rise in the rural death-rate at ages 5-35 corresponds roughly to the fall at the same ages in the metropolis. The curves for females are not very different from those for males; but all the curves for females are closer together than those for males, and at ages 15-35 the rural curve is actually higher than the metropolitan curve.

Reduction of Death-rate from Tuberculosis according to age.—The course of the death-rate from pulmonary tuberculosis and from all forms of non-pulmonary tuberculosis during recent years is shown in the table at the foot of page xci. It is interesting to compare the percentage reduction in deaths from all forms of tuberculosis at different ages in the two sexes. This is shown in the following table, the experience of 1912 being compared with the average experience of 1891-1900. For each age-period the death-rate from tuberculosis in 1891-1900 is taken as 100 and the death-rate in 1912 is stated proportionately to this.

	Age-periods.										
	0—	5—	10—	15—	20—	25—	35—	45—	55—	65—	75 and up-wards.
Males ...	55	21	18	25	29*	28	31	26	15	15	6
Females ...	52	27	20	21	25	33	37	32	24	11	+18

After the first five years of life, the rate of reduction in the death-rate does not differ very markedly in the two sexes up to the age of 25. The decline after this age among men is smaller than among women; and it appears likely that this may be due to the fact that improvement in industrial conditions has not been commensurate with the improvement in home life.

The figures for the first five years of life can scarcely be taken at their face value. At this period of life the death-rate from all forms of tuberculosis, as recorded, was 1·82 per 1,000 living of both sexes in the year 1912. At different periods of this quinquennium the death-rate (Reg. Gen. Ann. Rep., 1912, p. 65) was as follows:—

England and Wales.—Death-rate from Tuberculosis, 1912.

					Ages.		
					0-1.	1-2.	2-5.
Males	...	...	...	...	3·08	2·88	1·15
Females	...	...	...	...	2·55	2·49	1·09

The excessive death-rate in the first year of life is scarcely consistent with the fact that at this age the majority of infants, being breast-fed, have had the fewest and shortest opportunities of infection. These rates appear still more dubious in the light of the data for different parts of the first year of life given on page xlii of the Registrar-General's Report for 1912.

Death-rate from Tuberculosis.

					Under 3 months.	3-6 months.	6-12 months.
Average for year, 1902-06	...	...	...	...	·91	1·74	2·98
"	"	1912	...	...	·39	·78	1·64

The high death-rate under the age of six months, and the excessive decline of this death-rate at these ages are consistent with the view that there has been marked increase of caution in diagnosing tuberculosis in these early months; though it is not unlikely that a portion of the decline may be due to diminished infection from human sources and from cows' milk.

Local Distribution of Death-rates.—In my last annual report I discussed in detail the degree of reliability of local tuberculosis statistics, with special reference to the influence of migration on the death-rates. Two maps were given showing the county distribution of phthisis death-rates for males and females.

Similar maps are not given this year, but in Appendix A, No. 17, the crude and standardised death-rates from pulmonary tuberculosis and from all non-pulmonary tuberculoses in the two sexes in the administrative counties, county boroughs and metropolitan boroughs of England and Wales are given.

Many of these areas, owing to their small population, show wide accidental variations in their death-rates from tuberculosis in successive years. For this reason the above-mentioned tables have been calculated on the basis of the deaths in the two years 1911-12, and it is intended to continue them year by year, gradually increasing the period included in the results.

In Fig. 11 are shown the death-rates from pulmonary tuberculosis among males in the sixteen counties having the highest and the sixteen counties having the lowest death-rates in 1911-12. The three counties with the highest death-rates are Welsh counties (Cardigan, Merioneth, and Carnarvon), Cornwall coming next, two Welsh counties following in order. Two Welsh counties (Glamorgan and Monmouth) occupy the lowest end of the scale. In my last annual report I alluded to the likely influence of migration in aiding the production of these exceptional rates, especially in the mining counties.

Among females (Fig. 12) six Welsh counties head the list in magnitude of death-rate, Rutland, Surrey, Westmorland, and Warwick occupying the opposite end of the scale. The low male death-rate from pulmonary tuberculosis in the county of Glamorgan (.72) is in marked contract to its relatively high female death-rate (.96).

Fig. 11.

Showing Average Standardised Death-Rates from Pulmonary Tuberculosis, 1911-12, for Males, in Administrative Counties having an exceptionally high or low rate of Mortality.

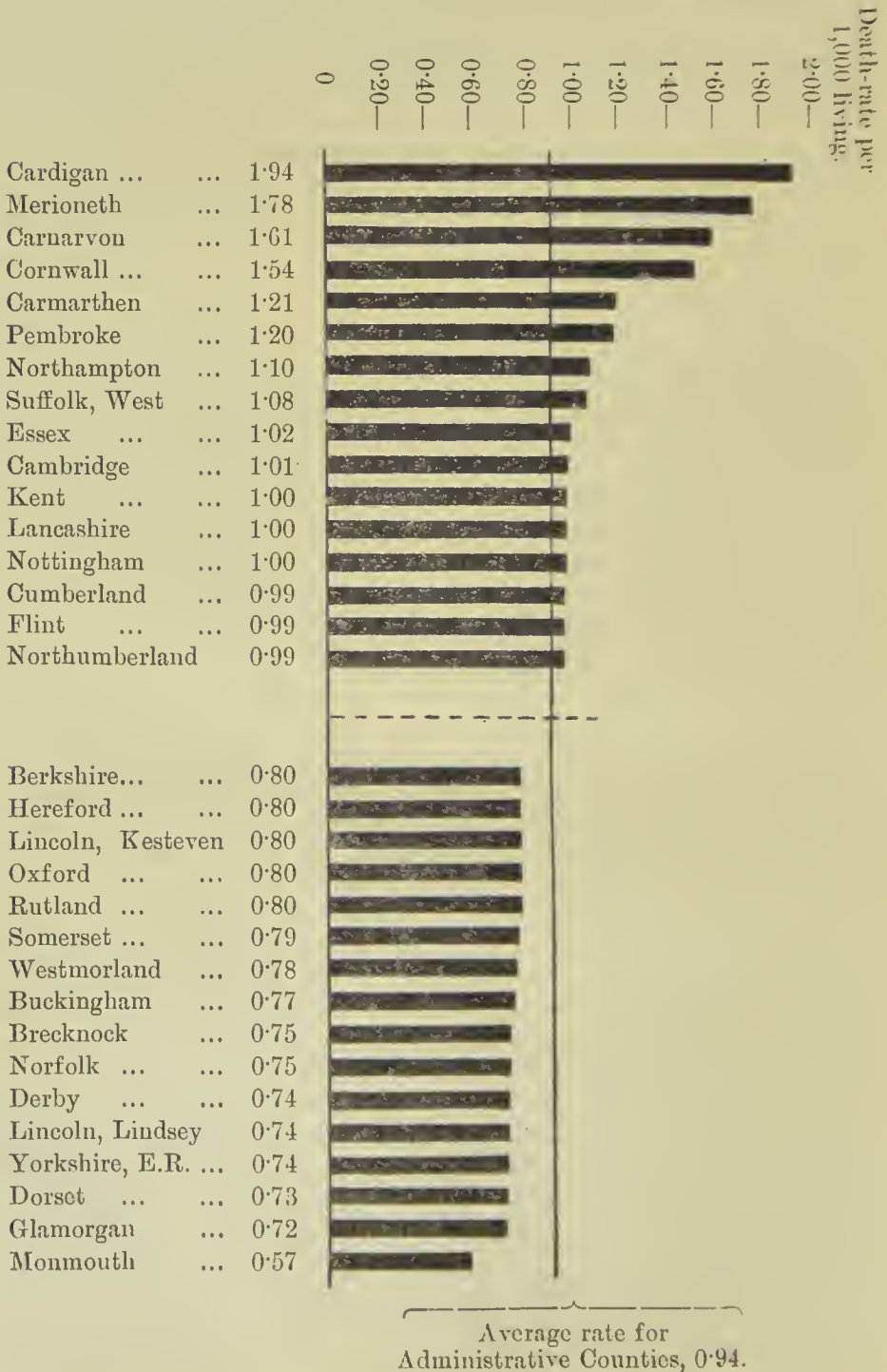
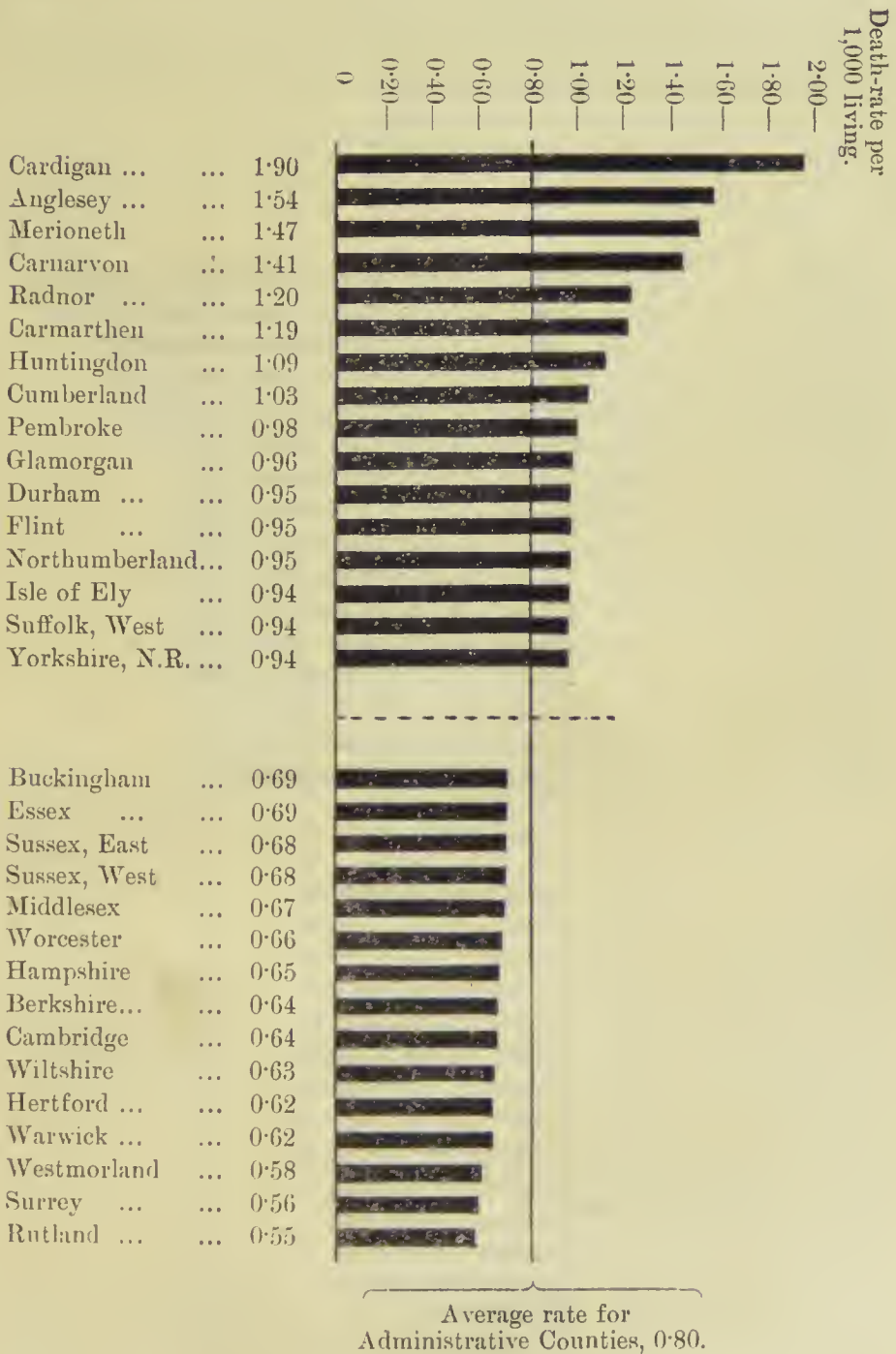


Fig. 12.

Showing Average Standardised Death-Rates from Pulmonary Tuberculosis, 1911-12, for Females, in Administrative Counties having an exceptionally high or low rate of Mortality.



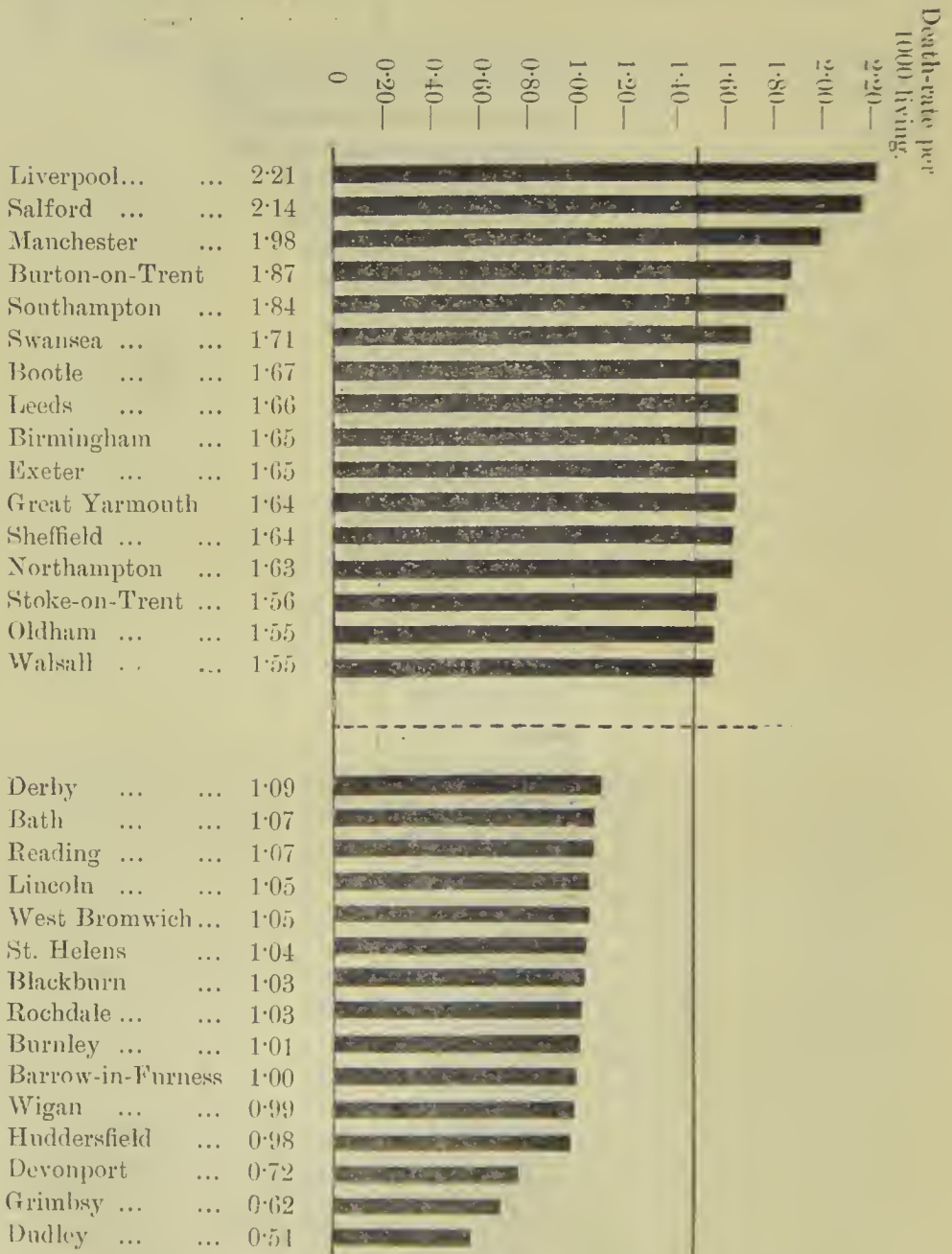
For county boroughs the sixteen highest and the fifteen lowest death-rates among males are shown in Fig. 13. Liverpool, Salford, Manchester, and Burton-on-Trent are the highest on the list;

Dudley, Grimsby, Devonport, and Huddersfield occupying the most favourable places.

Among females (Fig. 14) Tynemouth, Bootle, Swansea, and Liverpool have the highest death-rates; Dudley, Southport, Huddersfield, and Eastbourne the lowest death-rates.

Fig. 13.

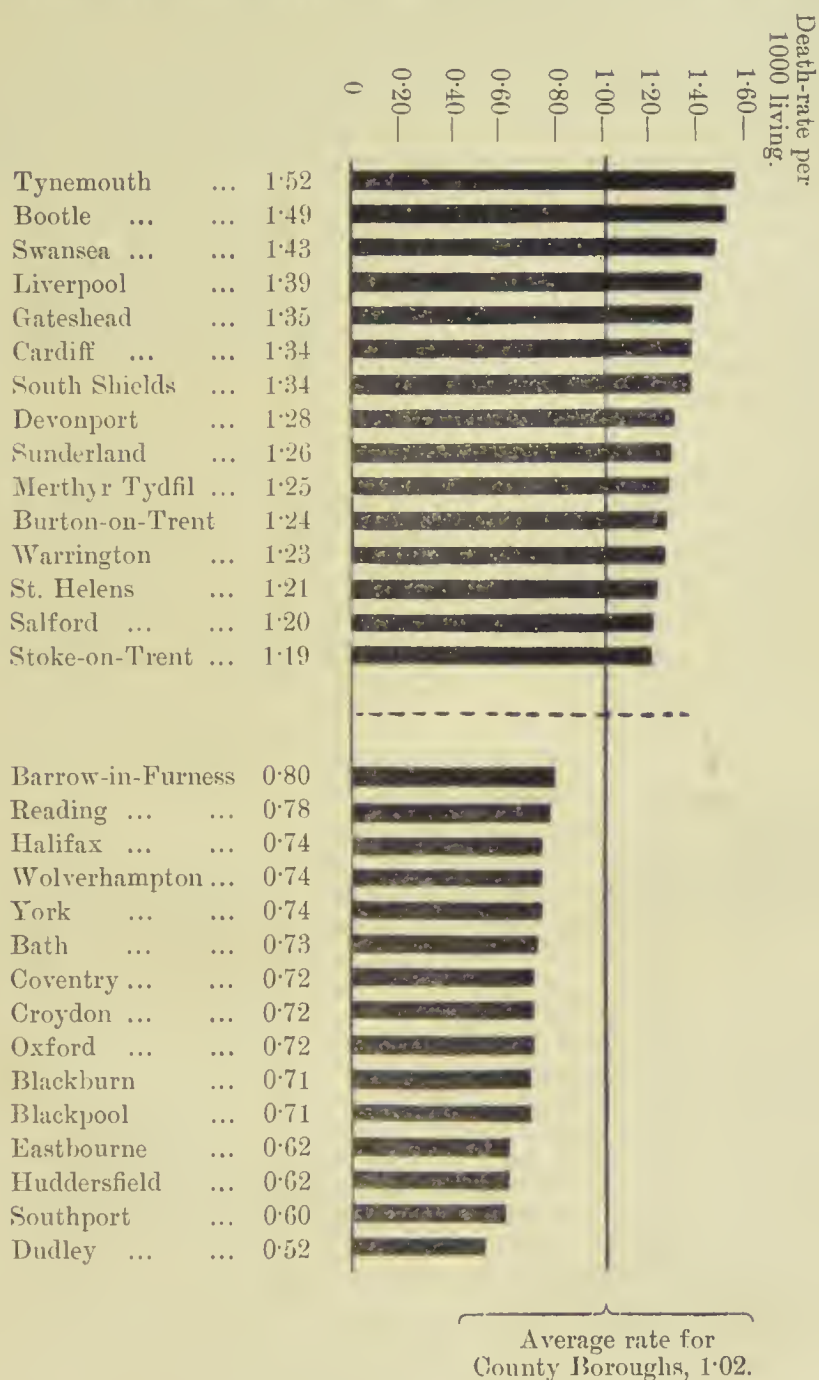
Showing Average Standardised Death-Rates from Pulmonary Tuberculosis, 1911-12, for Males, in County Boroughs having an exceptionally high or low rate of Mortality.



Average rate for
County Boroughs, 1.49.

Fig. 14.

Showing Average Standardised Death-Rates from Pulmonary Tuberculosis, 1911-12, for Females, in County Boroughs having an exceptionally high or low rate of Mortality.



Statistics of Cases of Tuberculosis.—In last year's report (p. xxix.) it was stated that death-rates form our most satisfactory means for determining the local incidence of tuberculosis. In the light of a further year's experience it is now possible to express a more definite opinion as to the statistical value of notification figures. Pulmonary tuberculosis was notifiable

throughout England and Wales during the whole of 1913 and non-pulmonary forms of tuberculosis from February 1st, 1913. In the following tables correction has been made for the one month's lacking statistics, and the notifications have then been stated in their ratio to total deaths from pulmonary and non-pulmonary tuberculosis respectively.

During the last eleven months of 1913, 43,168 cases of pulmonary tuberculosis among males and 37,620 among females were notified for the first time by practitioners. The corresponding figures for non-pulmonary tuberculosis were 18,952 notifications of male and 17,399 notifications of females cases. Of this number 5,445 were notified by school medical inspectors, viz., 1,441 cases of pulmonary and 1,355 of non-pulmonary tuberculosis in boys and 1,503 cases of pulmonary and 1,146 of non-pulmonary tuberculosis in girls. Stated in their proportion to deaths, the notifications by private practitioners and by school doctors were as follows:—

England and Wales.—Number of Notifications per 100 deaths from

	Pulmonary Tuberculosis.		Other Tuberculosis.	
	Males.	Females.	Males.	Females.
59 Administrative Counties	201	211	279	278
76 County Boroughs	225	266	369	375
29 Metropolitan Boroughs	245	336	441	442

Taking these average experiences, it would appear that for pulmonary tuberculosis there are from 25 to 20 notifications for every ten male deaths, and from 34 to 21 notifications for every ten female deaths. For other tubercloses the proportion varies from 44 to 28 per ten deaths. When the experience of individual counties is taken, the variations are much greater. Thus, in the administrative county of Nottingham only about 140, in Lancashire about 170, in the West Riding about 180 notifications of pulmonary tuberculosis among males to 100 deaths from this disease occurred, whereas in Somerset the ratio was about 270, in Worcestershire about 260, in Cumberland and Glamorgan about 250. Although no certain inference can be drawn from them until after several years' experience has accumulated, the medical officer of health of a district in which the notifications of phthisis do not number more than twice the deaths from this disease may advisedly consider whether in his area there is not failure to notify, and whether the local administrative arrangements for the control of tuberculosis are such as to ensure the confidence of the local medical practitioners and patients.

The examples given above will be given on an extended scale in next year's report. Meanwhile the discrepancies indicate the need for local inquiry as to the extent to which the obligation to notify is being fulfilled; and it is evident that notification statistics cannot be used as a trustworthy index of the relative prevalence of tuberculosis in different areas. The chief present use of notifications apart from the preventive action rendered practicable in respect of the patient actually concerned is to form a starting point for investigation which may lead to the discovery of unnotified cases.

SECTION VI.

VENEREAL DISEASES.

For several years past it has been evident that the social convention of silence respecting these diseases and the absence of direct measures for their prevention was accompanied by very serious injury to the public health. Medical opinion has gradually compelled public attention to the subject and especially to lines of preventive action which have now become practicable.

Successful preventive action has been brought within reach by pathological and physico-chemical research. The first pathological advance was the success of Metchnikoff and Roux in 1903 in conveying syphilis to the lower animals by the inoculation of monkeys. This was followed in 1905 by Schaudinn's discovery of the protozoal organism causing syphilis, the *spirochæta pallida*. This organism is discoverable in the primary lesions; and examination for its presence gives a most valuable aid to early recognition of the disease, before constitutional infection has occurred.

In 1906 von Wassermann, working in conjunction with A. Neisser and Bruck, introduced his test for the presence of syphilis, which enables treatment to be begun before secondary symptoms occur, with a prospect of success which is much greater than was previously possible. By its means the syphilitic character of otherwise dubious illness can be confirmed, and the right treatment can be secured.

The introduction at the end of 1910 of salvarsan as a remedy for syphilis has made treatment much more successful. The rapidity with which the external lesions of syphilis disappear under treatment by salvarsan is most remarkable; and apart from the question as to whether salvarsan produces a permanent cure, its abolition of the directly infectious lesions is a great public gain.

In view of the additional knowledge roughly summarised above, and of the importance of further action against venereal disease, the Board in March, 1912, decided that an inquiry should be made into the Control over Venereal Diseases, with special reference to the adequacy and general character of the

arrangements for institutional treatment of these diseases not available in England and Wales.

Dr. Johnstone, a medical inspector of the Board, was instructed to undertake this inquiry; and his report on the subject (Cd. 7029), which was presented as a Parliamentary paper early in August 1913, gives an excellent summary of our knowledge of the subject, and of the main lines of administrative action against venereal diseases which are immediately practicable. In view of the importance of the report, I reproduce here the chief paragraphs of remarks which I prefixed to this report.

It was recognised that the inquiry must be limited in extent, and be of a "sampling" description. The report, based on an inquiry thus limited, suffices, I think, to enable certain broad conclusions to be drawn, and even for administrative action, though as indicated later, further inquiry will be valuable.

In order that the control of venereal diseases and the adequacy of the institutional treatment available for them may be considered intelligently, Dr. Johnstone has prefaced his report on these points by a brief summary of our present knowledge of venereal diseases and particularly of syphilis.

The venereal diseases requiring serious consideration are gonorrhœa and syphilis. The first-named is the less important of the two, although it is a frequent cause of chronic suffering and sterility in women, as well as the chief source of blindness occurring as the result of ophthalmia of the new-born. For preventing the serious consequences of this last-named disease much active work, happily, is already being done by Sanitary Authorities

The serious extent to which syphilis affects the national health is not generally realised. It is an important cause of arterial degeneration and of heart disease; the chief if not the only cause of locomotor ataxy and general paralysis of the insane, as well as of various forms of skin and bone diseases.

The virus of syphilis can be and commonly is transmitted from the parent to the fetus *in utero*. The immediate result often is abortion or miscarriage. All the evidence available indicates that complete notification of still-births followed up by medical enquiry would lead to the discovery of a large amount of hitherto undetected syphilis, and would thus enable a large mass of disease to be treated, and its transmission prevented. Apart from still-births, syphilis is a frequent cause of premature birth and of the "Marasmus" and "Atrophy" which bulk largely in the causes of mortality in the first month after birth. As shown in a recent report to the Board (Cd. 6909), the death-rate in the first and to a less extent in the next two months of infancy has yielded to improved conditions much less than the death-rate in the later months. Evidence is accumulating to show that an important share of this early infant mortality, as well as of still-births, will be avoided when systematic measures are taken for the recognition and treatment of syphilis in expectant mothers. Inherited syphilis in later years may

cause blindness, deafness, and various bone, skin, and visceral lesions in the infected child

In his report, Dr. Johnstone emphasises the practical point that syphilis is spread less by habitual or professional prostitutes, than by women who are only occasional prostitutes and by men "who have neglected to secure competent advice or to observe it when given." Hence it is impracticable to attempt to repress this disease by restrictive measures of the type of the former Contagious Diseases Acts. We must look to other means of control applicable with a fair degree of equality to all concerned, of both sexes. The possibility of securing these has been greatly increased by the discovery of the causal micro-organism, the elaboration of the Wassermann test for presence of the disease, and the use of salvarsan for the rapid removal of infectivity by removing the symptoms of the disease.

In view of the invaluable aid in the prompt recognition and treatment of syphilis at all its stages rendered available by these means, it is of primary importance, in the public interest, that facilities for gratuitous Wassermann and allied tests should be made available throughout England and Wales.

Syphilis illustrates more forcibly even than tuberculosis the importance of treatment as a means of preventing the spread of disease. This was true in regard to the older methods of its treatment. If, as is now generally believed, the duration of active symptoms is greatly decreased and relapses are much less frequent when salvarsan is administered, this truth becomes still more important. The valuable work done at the Military Hospital, Rochester Row, London, shows that when treatment is by salvarsan, patients do not usually need to be in-patients in hospital for more than one or two days at the time of each injection. Possibly longer than this might be needed for patients under less control than are soldiers; but modern methods of treatment of syphilis appear to have brought within easily manageable limits the problem of the hospital treatment of infectious syphilitic patients. In the past such patients, when discharged from infirmaries or hospitals, were extremely likely to spread disease; in future this scarcely need be so.

It is evident from Dr. Johnstone's Report that the amount and character of the institutional treatment available in England and Wales for syphilis is unsatisfactory. There are very few hospitals specially devoted to venereal diseases, and it is doubtful if increase in their number would be the best line of administrative action. General hospitals very rarely reserve beds or wards for venereal cases, though patients suffering from the later consequences of neglected treatment of both syphilis and gonorrhœa are occupants of a not inconsiderable proportion of their beds. Many general hospitals have provision for applying the Wassermann test, and a few patients have been admitted to these hospitals for treatment by salvarsan. Dr. Johnstone reports the venereal wards of the Poor Law Infirmarys which he visited

as being generally well kept and well administered, but the accommodation provided for venereal cases in the work-houses visited by him as a rule was not well adapted to the treatment which these cases require. It is evident that for the vast majority of patients suffering from syphilis in its active earlier stages there is everywhere a great dearth of the best means of accurate diagnosis and of the best methods of treatment under acceptable conditions; and that in consequence a large amount of serious avoidable disease continues its ravages.

The essential remedies required to reduce this evil are set out in the following paragraph from Dr. Johnstone's Report:—

“ It cannot be too strongly urged that the best method of controlling venereal diseases and protecting the free from infection would be the provision of means for early and accurate diagnosis, with skilled advice and adequate treatment available for all infected persons. In short, the essence of the problem is how to get a willing patient at the earliest time to the doctor from whom or to the institution from which such advice and treatment is to be had.”

The means for securing the carrying out of these remedies need further inquiry, and such inquiry is desirable, as well as more exhaustive investigation of the subject generally. It is probable that the subsidisation of accommodation in general hospitals, where modern means of treatment could be ensured, would be more successful than the erection of special hospitals. Through these hospitals or by means of public health laboratories, every doctor should have access to the most efficient means of laboratory diagnosis of syphilis or gonorrhœa.

I concur in Dr. Johnstone's view that notification of venereal diseases is not at present to be recommended. Under present circumstances it would tend to concealment of disease and delay in or neglect of skilled treatment. The operation of the National Insurance Act will, it may be hoped, lead to the detection of a large amount of this disease hitherto neglected; and the immediate practical problem is the means for providing for the population as a whole readily accessible and unfettered means for diagnosis and treatment. This should have priority over the question of formal notification.

In November, 1913, His Majesty the King appointed a Royal Commission

to inquire into the prevalence of Venereal Diseases in the United Kingdom, their effects upon the health of the community, and the means by which those effects can be alleviated or prevented, it being understood that no return to the policy or provisions of the Contagious Diseases Acts of 1864, 1866, or 1869 is to be regarded as falling within the scope of the inquiry.

The following were appointed to constitute the Commission: Baron Sydenham of Combe (Chairman), Sir David Brynmor Jones, Sir Kenelm Digby, Sir Almeric Fitzroy, Sir Malcolm Morris, Sir John Collie, Dr. Newsholme, Canon Horsley, Rev. Dr. Scott Lidgett, Dr. Mott, Dr. Mary Scharlieb, Mr. J. E. Lane, Mr. Snowden, M.P., Mrs. Creighton, and Mrs. Burgwin. The Commission have been holding meetings since 7th November, 1913, and recently have issued a formal first report to which is appended the minutes of evidence up to 6th April, 1914 (Cd. 7475).

As the Commission is still sitting, further comment on the subject is premature.

Ophthalmia Neonatorum.—In February, 1914, the Board made Regulations under Sec. 130, Public Health Act, 1875, providing for the compulsory notification by medical practitioners and certified midwives of cases of ophthalmia neonatorum commencing in infants within twenty-one days from the date of their birth, on whom they are in attendance. The Order required the medical practitioner in attendance to give the name and address of the parent of the child, the date of its birth, and the date of onset of the disease. This Order came into operation on 1st April, 1914.

Ophthalmia neonatorum had been previously added to the list of locally notifiable diseases by a number of local authorities, under the Infectious Disease (Notification) Act. The extent to which this had been done is shown in the following summary tables:—

OPHTHALMIA NEONATORUM.

Summary of Notifications in complete Years since adoption of Notification.

	Notification in force during							
	4 years (1910-1913).				3 years (1911-1913).			
	Population, 1911.	Average No. of Births per an- num, 1910-12.	Total Notifications.	Average annual Case-rate per 1,000 births.	Population, 1911.	Average No. of Births per an- num, 1910-12.	Total Notifications.	Average annual Case-rate per 1,000 births.
Urban dis- tricts.	751,197 (3 dis- tricts).	19,590	1,617	20·6	6,647,008 (76 dis- tricts).	167,700	4,425	8·4
Rural dis- tricts.	—	—	—	—	77,465 (6 dis- tricts).	1,720	8	1·6
Total ...	751,197 (3 dis- tricts).	19,590	1,617	20·6	6,724,473 (82 dis- tricts).	169,420	4,233	8·3

(continued.)

	Notification in force during							
	2 years (1912-1913).				1 year (1913).			
	Population, 1911.	Average No. of Births per an- num, 1910-12.	Total Notifications.	Average annual Case-rate per 1,000 births.	Population, 1911.	Average No. of Births per an- num, 1910-12.	Total Notifications.	Average annual Case-rate per 1,000 births.
Urban dis- tricts.*	8,883,195 (118 dis- tricts).	230,395	3,810	8.3	10,809,196 (162 dis- tricts).	279,921	1,898	6.8
Rural dis- tricts.	360,454 (24 dis- tricts).	8,199	17	1.0	687,374 (53 dis- tricts).	15,063	15	1.0
Total ...	9,243,649 (144 dis- tricts).	238,594	3,827	8.0	11,496,570 (215 dis- tricts).	294,984	1,913	6.5

* Including county and other boroughs.

Up to the date on which the Board's Order for the notification of ophthalmia neonatorum came into force, this disease had been made notifiable under the Infectious Disease (Notification) Act for a population of 12,839,315 or 35.6 per cent. of the total population of England and Wales.

The differences between the case rates for urban and rural districts shown in the preceding tables are noteworthy; and they probably correspond to real differences in the incidence of the disease. The case rates in urban communities also vary greatly among themselves. Whether this corresponds to an equal difference in the incidence of the disease must be regarded as somewhat doubtful. The following are examples of striking differences:—

Cases Notified per 1,000 Births.

Manchester	...	...	21.4 (four years' experience)
London	...	...	5.7 (three)
Stoke-upon-Trent	...	...	28.1 (.. ..)
Birmingham	...	...	9.9 (two)
Nottingham	...	...	11.2 (.. ..)
Southwark	...	...	10.8 (three)
Finsbury	...	...	2.5 (.. ..)

The prevention of the disease is best secured by the prevention of gonorrhœa, or, failing this, its discovery and treatment in the mother before parturition. At the confinement, if the mother has purulent leucorrhœa, the prophylactic application of a weak silver solution to the infant's conjunctivæ is indicated, and apart from this the use of aseptic precautions at birth and

after birth for the infant's eyes. If an attack of ophthalmia develops, the saving of the infant's eyesight, and possibly of its life, commonly depends on the assiduous irrigation of the eyes, a nurse usually being almost continuously needed for this purpose.

The Board have informed a number of sanitary authorities making inquiries on this point that they can, with the Board's consent, under the powers given by Section 133 of the Public Health Act, 1875, give nursing assistance to poor patients suffering from this disease.

SECTION VII.

MISCELLANEOUS WORK OF MEDICAL DEPARTMENT.

The matters, other than those already referred to, which have occupied your medical staff during the year included the following further subjects.

Local Investigations as to Disease Prevalence, Sanitary Circumstances, Hospital Provision, Housing, &c.

A list of the inquiries by medical inspectors in these various matters is given on pages 76 to 82; and on pages 83 to 103 the results are summarised of the more important inspections made during the year, both in regard to incidence of disease and to sanitary administration.

A considerable number of isolation hospitals was visited and reported on, and there were many conferences and interviews at headquarters with representatives of hospital-providing authorities. These visits and conferences were necessitated by the large number of cases in which during the year additions to existing isolation hospitals were proposed or new isolation hospitals provided.

Among the inquiries as to the sanitary circumstances of individual localities, those having special reference to housing conditions occupied much time of the medical staff during the year. These are enumerated under a separate heading on page 78. Particular reference may be made to a series of inspections of sanitary districts in the West Riding and in Gloucestershire, by Dr. Carnwath; to a similar series in various parts of Wales, by Dr. Morgan Rees; and to inspections in St. Neots rural district and other districts in Huntingdon by Dr. Hutchinson. In the present year reports largely bearing on housing conditions have been separately issued for the urban districts of Padiham and Dartmouth.

The results of these inspections, so far as they concern housing conditions, form part of the Board's housing work reported upon in Part II. of the Board's report for 1913-14 (C'd. 7610). In the instances in which the investigations of housing conditions have been made by medical inspectors, there have usually been concurrent conditions of sanitary administration in addition to

housing which made it desirable that the investigation should not be limited to questions of housing. In the course of these inquiries the importance of giving attention to general sanitary improvements, particularly in rural and smaller urban districts, collaterally with the systematic inspection of houses now made obligatory by the Housing, Town Planning, &c., Act and Housing Regulations, has often been illustrated.

In several instances medical inspectors have found that local arrangements for sanitary inspection which might have sufficed in years preceding the operation of the Housing Regulations have been inadequate to meet the demands of modern administration. It has sometimes been clear that the terms and conditions of appointment of the medical officer of health, or the time at his disposal, are quite inadequate for the satisfactory performance of duties required under the Public Health and Housing Acts and the Board's Order relating to the duties of his office. In other instances, particularly in rural districts of large area, the rate of progress of inspection or its thoroughness has been materially hampered owing to insufficient action by the inspector of nuisances who is usually the officer designated for inspection under the Housing Regulations. Sometimes the circumstances have involved the need for a change of personnel, or additional appointments, and in others it has appeared that much of the difficulty could be removed by providing officers with better facilities for locomotion and with assistance in clerical work.

Dr. Mivart's report on the general sanitary circumstances and administration of the borough of Dartmouth shows, as he states in his report (New Series, No. 90), "that a number of weighty questions gravely affecting the good government and health of the borough are awaiting consideration by the town council whose supineness for many years has permitted the gradual growth of a large number of insanitary conditions, many of them now difficult of abatement."

Among these the remedying of the numerous sanitary defects in the older parts of the town and the enforcement of reforms in housing are specially called for.

Work in connection with the approval of Byelaws and Regulations, &c.

During the year numerous questions have been referred to the Medical Department in connection with various Bills before Parliament and with applications for Provisional Orders. These have related especially to public water supplies.

Following on the issue of the Board's circular of August, 1912, the revision of local byelaws for New Streets and Buildings, in order to make them more flexible and less restrictive of building operations, has occupied considerable attention. In a large number of cases, especially in rural districts which had codes of an urban character, less stringent byelaws of the intermediate or rural code have been substituted as the result of this circular. The staff of the medical department has been called upon to advise on byelaws in a large number of instances, especially where a

knowledge of the sanitary circumstances of the locality was needed. Numerous conferences with local authorities have been held for the purpose of discussing and settling debatable questions.

It has been necessary in several instances, in order to settle outstanding points, for local inspections to be made by members of the architectural and medical departments jointly. Such inspections were made of the boroughs of Folkestone and Sandwich, in order to decide on the provisions to be made for requiring open space in the front and rear of re-erected dwellings in the older and congested parts of these boroughs, and other matters. Cookham, Tamworth, Romford, and South Stoneham rural districts were also inspected in order to decide as to the codes of building byelaws which were most suitable for these areas or parts of them. Advice has been given in a number of instances where revision of local building byelaws has been needed in order to allow of housing schemes, which would otherwise conflict with the byelaws in certain particulars, being completed in accordance with byelaws in force.

On the issue by the London County Council of draft byelaws, under the London General Powers Act, 1908, relating to the conduct of certain offensive trades in London, petitions against confirmation were received by the Board from a large number of traders dealing in waste products, such as soap makers and bone boilers, and from a large number of traders usually termed "marine-store dealers." Dr. Hutchinson made inquiries for the Board into these representations, as a result of which certain modifications in the byelaws, so far as they affected dealers in rags, were suggested to and accepted by the County Council. The opportunity was taken to obtain information from provincial towns also on the conditions of the wholesale and retail trade in rags, and of the business of "rag and bone dealer," in order that local authorities desiring to include this trade among offensive businesses under Section 51 of the Public Health Acts Amendment Act, 1907, might be advised as to the definition of "rag and bone dealer" which should be adopted in any Order made under that section, and as to the nature of byelaws most suitable for the prevention of offensive nuisance from the trade in question.

As a result of local inspection of a considerable number of premises in London and elsewhere which are underground sleeping rooms of the kind referred to in Section 17 (7) of the Housing and Town Planning, &c., Act, 1909, and of information contained in reports from medical officers of health, draft regulations were prepared during the year for the guidance of local authorities in exercising their powers under this section. A copy of these regulations is sent to each local authority making application for confirmation of regulations on the subject. It is desirable that medical officers of health in towns which contain houses with underground rooms which are used for sleeping purposes, whether in separate occupation or not, should take advantage of the powers which can be obtained by the adoption of regulations on these lines.

Public Water Supplies and Lead Poisoning.

In my annual report for 1908-9 (p. 189) a memorandum was given which brought up to date our information as to the ability of certain public water supplies, principally those of moorland origin, to act on lead. In previous annual reports the results of special investigations into the causes which lead to water acquiring plumbo-active properties had already been set out. In August, 1913, Dr. F. Seymour inquired on behalf of the Board into the alleged occurrence of lead poisoning in the urban district of Guisborough, in Yorkshire, and its relation to the ability to act on lead of the water supplied by the Guisborough Water Company. The report is reproduced in Appendix A. No. 7. The facts obtained by Dr. Seymour leave little doubt that lead poisoning, usually slight in its manifestations, had been widely prevalent in this district during the year, and that its occurrence was due to the action of the water of the public supply on the long lengths of lead service pipe which are commonly used in the district.

It was not easy to ascertain whether the lead poisoning had been continuing for many years practically unnoticed until suspicions were aroused in 1913, or whether there was an actual change in the condition of the supply in that year which caused the water to become more active as regards lead; probably both had occurred. Since 1912, the water, which was of peaty origin, and suspected to be liable in consequence to be acid, had been subjected to lime treatment, but it appeared that this treatment was not sufficiently regulated and governed by tests to be uniformly adequate to neutralise the acidity, while at times the lime may have been added in proportions considerably greater than was needed to counteract any acidity present in the water. Dr. Seymour considered that the treatment cannot be regarded as necessarily having removed properties of the water other than acidity, which enabled it to act upon lead, in particular its "erosive" properties. It was, indeed, conceivable that as a result of the treatment the destruction of the plumbo-solvent properties of the water was more than counterbalanced by the increased ability to erode lead which it acquired. The report, which was forwarded by the Board to the Waterworks Company, recommended that certain differential tests should be applied over a sufficient period in order that further information might be obtained as to the variations of the lead-acting qualities of the natural water, and as to the best means of treating it so as to remove these qualities.

Work of Inspectors of Foods.

The work which has been carried out during the year in the Food Inspection Branch of the Medical Department is reported on by Dr. MacFadden, on page 104. The inspectors of food have visited the chief food-importing ports and inquired locally as to the control carried out over imported foods under the Board's food regulations. In the course of visits to various districts they have also given much useful advice on points of detail to officers of

local authorities responsible for the administration of the Sale of Food and Drugs Acts and to those responsible for the inspection of local food supplies under the Public Health Acts.

Dr. MacFadden refers to the prevalence of lesions of actinomycosis in ox tongues imported from Argentina, and points out that the system of meat inspection in Argentina which allowed these tongues to be exported was defective. It is satisfactory to note that since the attention of the Argentine authorities was drawn to the matter great improvement has been observed in the condition of consignments of ox tongues arriving from Argentina.

In commenting on the working of the Public Health (Milk and Cream) Regulations, 1912, Dr. MacFadden draws attention to the renewed attempts made by unscrupulous makers of preservatives to induce manufacturers of food products to use certain preservatives which they claim are not easily detected by the public analyst, and which have been found on analysis to contain fluorides and benzoates. As dealers in milk and cream are the object of special attention on the part of these preservative makers it is obvious that deliberate attempts are being made to induce dealers in milk and cream to infringe the provisions of the Public Health (Milk and Cream) Regulations.

Dr. MacFadden refers (p. 109) to an outbreak of food poisoning occurring at Newcastle-on-Tyne which was caused by the milk from a cow infected with septicaemia following parturition having been mixed with the general milk supply from a farm. The case is remarkable for the completeness of the chain of evidence which was obtained in tracing the cause of the outbreak, a result which was largely due to the promptness and thoroughness with which its investigation was undertaken by the medical officer of health.

Work in the Board's Pathological Laboratory.

Dr. Eastwood's report on the work carried out in the above mentioned laboratory is printed on p. 118.

The principal research work undertaken during the year was the investigation into the incidence and nature of tuberculosis occurring in children whose deaths were attributed to other causes. The report on this investigation together with a collateral one by Dr. A. Griffith of Cambridge on the same subject was issued during the year. Comments on this report will be found on p. cxviii.

Work in the Government Lymph Establishment.

Dr. Blaxall's report on the work of the Government Lymph Establishment is given on p. 116.

During the twelve months ended 31st March, 1914, 366,716 capillary tubes of glycerinated calf lymph were issued to public vaccinators from the establishment as compared with 384,498 in the previous year. The lymph issued by the Board in 1913-14 maintained its customary high quality: in primary vaccination the "case success" was 99·4 per cent., and the "insertion success" 96·0 per cent.

In addition, lymph has continued to be supplied for the use of the Navy (26,630 tubes), and of the Army (55,507 tubes), the Local Government Board for Scotland (1,960 tubes), and the Isle of Man (449 tubes).

VACCINATION AND PUBLIC VACCINATION.

Inspection of Vaccination.

During the 12 months ended 31st March, 1914, 130 unions, comprising 735 vaccination districts, were inspected in regard to vaccination. 634 public vaccinators received special awards under section 5 of the Vaccination Act, 1867, the total sum awarded being £14,569 11s.

Vaccination Officers' Returns.

In the report of your medical officer for 1910-11 (pp. 272-301) was included a quinquennial return on vaccination. For information on the progress of vaccination up to the date covered by the return in any individual union in England and Wales reference should be made to this and previous returns.

On page 120 will be found tables compiled from the annual returns of vaccination officers with respect to infants whose births were registered in 1912. These statistics are compiled in the Board from returns submitted by vaccination officers, which reach the Board 13 months after the completion of the year to which they relate. Thus the returns for 1912 were received in February, 1914.

The following tables, which summarise these returns and compare them with those of previous years, are a continuation of those published in previous annual reports:—

England and Wales.

Observance of the Vaccination Laws as a whole in 1898 and in subsequent years.

Year.	Births.	Vaccinated.	Insusceptible.	Had Small-pox.	Exempted.	Died.	Postponed.	Remaining.	Not accounted for (including cases postponed) per cent. of Births.
1898 ..	923,059	562,737	3,232	4	47,423	110,912	16,921	181,830	21·5
1899 ..	929,189	517,113	5,379	4	33,573	113,516	16,605	142,999	17·2
1900 ..	927,222	636,940	2,261	2	39,699	103,538	14,225	130,557	15·6
1901 ..	929,882	664,366	2,631	27	39,925	102,007	12,317	108,609	13·0
1902 ..	940,509	703,721	3,027	27	33,759	90,826	12,213	96,936	11·6
1903 ..	948,383	714,637	2,573	17	37,675	91,754	12,489	89,238	10·7
1904 ..	945,500	711,504	2,878	22	40,461	94,686	12,723	83,428	10·2
1905 ..	929,540	706,040	2,252	8	44,369	84,712	13,175	79,984	10·0
1906 ..	935,338	686,992	2,203	6	53,828	88,553	14,378	89,386	11·1
1907 ..	918,341	651,050	1,926	1	76,709	78,513	14,916	95,226	12·0
1908 ..	940,640	594,792	2,438	2	160,350	80,188	14,333	88,537	16·9
1909 ..	914,844	547,279	2,230	1	197,342	70,388	13,919	83,635	10·7
1910 ..	897,273	501,638	1,592	0	233,677	67,768	12,702	79,996	10·3
1911 ..	881,159	460,598	2,492	0	250,798	75,066	12,053	80,152	10·5
1912 ..	872,799	436,951	1,367	0	280,529	60,238	12,552	81,162	10·7

“ Abstention ” from Vaccination and “ Acceptance ” of Vaccination in 1893-97 and in subsequent years.

	Per cent. of Births in each instance.								
	1893-97.	*1898.	1899-1906.	1907.	1908.	1909.	1910.	1911.	1912.
ABSTENTION. ("Exempted," "postponed," and "remaining.") (Exemptions alone) ...	21·0	26·6	16·7	20·4	27·9	32·3	36·3	38·9	42·9
ACCEPTANCE. (Vaccinated) ...	67·7	61·0	72·7	70·9	63·2	59·8	55·9	52·3	50·1

* The Vaccination Act, 1898, was only in operation for a portion of the year.

Of 872,799 births reported to the Board by the several vaccination officers in England and Wales as having been registered during the year 1912, the number which, at the time the return was made, had been registered as successfully vaccinated was 436,951 (being 50·1 per cent. of the whole), and the number registered as having died unvaccinated was 60,238 (or 6·9 per cent. of the whole). Of the remaining 375,610 children, 1,367 (or 0·2 per cent. of the whole) had been registered as insusceptible of vaccination; 12,552 (or 1·4 per cent.) as having their vaccination postponed by medical certificate; and 280,529 (or 32·1 per cent.) in respect of whom certificates of conscientious objection were received; leaving 81,162 (or 9·3 per cent.) as “removed,” “not to be traced,” or otherwise unaccounted for. If from the 872,799 births returned by these officers the 60,238 deaths that took place before vaccination be first deducted, it appears that, of the surviving 812,561 children, there were registered at the time of the return 53·8 per cent. as successfully vaccinated; 0·2 per cent. as either insusceptible of vaccination, or as having had small-pox; 1·5 per cent. as under medical certificate of postponement; and 34·5 per cent. in respect of whom certificates of conscientious objection to vaccination had been obtained; leaving 10·0 per cent. as at that time still unaccounted for as regards vaccination.

The proportion of cases unaccounted for in the metropolitan returns for 1912 is 20·9 per cent.; in the provincial returns 9·2.

In 1912 the proportion of cases unaccounted for (excluding the postponed cases) in the Metropolis and in the rest of England was 19·2 and 7·8 per cent. respectively.

In England and Wales, as a whole, one-half of the children whose births were registered in 1912 have been vaccinated, and nearly one-third have been exempted from vaccination by statutory declaration of conscientious objection.

The return for England and Wales for 1912 when compared with the return for 1911, shows a reduction from 52·3 to 50·1 in the proportion of children born who are vaccinated. The

percentage of children born who were exempted under certificates of conscientious objection increased from 28·5 to 32·1, while the children registered in 1912 living at the date of the return in February, 1913, who had neither been vaccinated nor legally exempted from vaccination form 10·7 per cent. of the registered births; as compared with 10·5 in the previous year.

Changes of Staff.

Two vacancies occurred in the staff of medical inspectors during the year owing to the death of Dr. R. Deane Sweeting and the resignation of Dr. J. R. Prior to take up an important post as a medical officer of health. The Board found it necessary to ask the Treasury to sanction the appointment of two additional medical inspectors owing to the increase in the work of the department.

To fill these vacancies Dr. F. R. Seymour who at the date of his appointment was serving as a temporary medical inspector, Dr. J. P. Candler, Dr. A. S. MacNalty, and Dr. E. Wilkinson were appointed.

I regret to record the loss to the Board through death of the valued services of Dr. R. Deane Sweeting who was the senior medical inspector in the Board's service. Dr. Sweeting was appointed in March 1890. His work for the Board has been concerned largely with vaccination inquiries, in which his experience was unequalled; but he also conducted numerous public inquiries as well as inquiries into outbreaks of infectious disease, the reports on which were published.

SECTION VIII.

AUXILIARY SCIENTIFIC INVESTIGATIONS.

Of the scientific investigations undertaken on behalf of the Board during the year 1913-14, Dr. M. H. Gordon's report on an experimental investigation in relation to epidemic parotitis (N.S. No. 96) and Professor Leonard Hill's report on ventilation and on the effect of open air and wind on the respiratory metabolism (N.S. No. 100) have been issued separately in the new series of reports on Public Health and Medical Subjects. The reports by Drs. Eastwood and F. and A. S. Griffith on the incidence and bacteriological characteristics of tuberculous infection in children have also been published separately (N.S. No. 88).

Professor Sims Woodhead's inquiry, begun during 1912-13, into the cellular contents of milk is still in progress; the results of the inquiry will be published during the coming year.

Dr. Alexander's investigation into the bacteriology of acute respiratory affections, with special reference to their clinical symptoms, has been extended for another year in view of the difficulty experienced by him in obtaining adequate material.

Drs. Twort and Mellanby have presented an interim report setting out the results of their inquiry into the subject of

epidemic diarrhœa, and on filter-passing micro-organisms; they are pursuing their investigations during the present year, and their reports will be published next year.

The reports by Messrs. Austen and Hesse and by Dr. Bernstein on hibernation of flies and on *Empusa muscæ* will be published shortly in a further report (No. 7) on "Flies as Carriers of Infection." This report will embody a preliminary statement summarising the Board's investigations on the subject to the present date.

Dr. Andrewes has been engaged during the last two years in an important investigation for the Board on the causes of arterial degeneration. In the report, which is printed in Appendix B, No. 1, he sets out his results on two important branches of this investigation. The first of these deals with the influence of infective conditions in determining degeneration of the arterial wall; and in the second Dr. Andrewes has made a study of the chemical analysis of the aorta in health and disease, as regards ash and calcium content.

In the first portion of the first branch of these investigations Dr. Andrewes has shown that there is evidence of actual bacterial invasion of the aortic wall in many common infective conditions, either by the primary infecting agent, or as a result of secondary infection. Such an invasion, although probably local and temporary, being ultimately, or indeed, soon overcome, must be regarded as able to excite a local inflammatory reaction, which, when overcome, may be replaced by a focus of fibrosis. This local damage of the middle coat of the aorta, although possibly trivial in itself, may later in life, when the aorta is subject to unusual stress, determine the distribution of sclerosis of the aorta.

In the second part of the first branch of his investigations Dr. Andrewes has studied carefully the evidence as to the part played by infection in the causation of arterial degeneration, to be derived from histological study. Apart from syphilis, the important rôle of which in producing arterial disease is well known, the results obtained go to show that in general infective diseases the aorta may not escape scot-free, even though the injury be trivial. He adds:—

"When it is remembered that few persons escape general infections at some period in their lives, it is not too much to say that we have here a probable cause, not perhaps of premature arterial degeneration as a whole, but at least of the premature local changes in the arterial wall which determine the distribution of some forms of nodular sclerosis."

In the second branch of his report Dr. Andrewes presents a study of the chemical analysis of the aorta in health and disease as regards ash and calcium-content. His object was to ascertain whether these data could be used as an index to the degree of degeneration in a given vessel, and he gives reasons for the belief that, with certain limitations, this is the case.

He presents analyses of some 90 aortas, singly and in groups, and endeavours to correlate his results with clinical facts more closely than has hitherto been attempted.

In order to establish a calcium standard, 41 normal aortas were collected. These were for the most part massed according to

age periods, but those from the third and fourth decades were analysed singly. In this way a normal calcium curve was obtained from infancy up to the eighth decade, illustrating the naturally occurring senile changes in arteries. It is shown that the curve is very low and flat up to the twentieth year, and remains low, though with slight increase, up to the fortieth year. A marked increase in calcium then sets in, corresponding to the period of onset of arterial decadence, and this increase continues steadily throughout the rest of life.

Dr. Andrewes then examines the ash and calcium figures from some 40 diseased aortas in relation to the normal curve. He shows that in uncomplicated syphilitic disease of the aorta the calcium figures are invariably below the normal, but that in old cases the parts unaffected by syphilis may become the seat of ordinary sclerotic changes, with much calcification.

In non-syphilitic arterio-sclerosis there is hardly any increase in calcium in the earliest stages, but when fatty degeneration and ulceration occur there is at once a great increase in lime salts, save in a few exceptional cases. In cases of high blood pressure the aorta does not appear to become degenerate for a considerable period. There is some evidence that the abuse of alcohol leads to premature arterial degeneration.

The chief interest of this report lies in the attempted establishment of the normal calcium curve for all ages, and its application in the interpretation of the figures from cases of disease.

Dr. Rajchman has made an investigation for the Board, the object of which was to enquire whether means could be devised for a serological diagnosis of scarlet fever. The search for specific anti-bodies in the patient's blood having been undertaken before by several investigators with little or no satisfactory results, it was decided to make an endeavour to obtain a specific diagnostic serum by means of which the unknown virus of scarlet fever might be detected in the various discharges of the patients. Samples of scarlatinal nasal discharge were extracted with anti-formin, and rabbits were immunised against these anti-formin extracts. It was found that the immune serum obtained, when applied for the complement fixation test in scarlet fever, for samples of nasal discharge, extracted by means of a 5 per cent. solution of anti-formin and tested with this serum, gave a positive reaction in a large percentage of cases. Samples of discharge from non-scarlatinal cases also gave a positive test, but in a relatively small proportion of cases (81.2 per cent.: 13.3 per cent.).

The results obtained cannot be regarded as final in the absence of further data with regard to other acute fevers.

Dr. Gordon, in his report on an experimental investigation in relation to mumps (N.S. No. 96), gave first an account of this disease and of its complications, with special reference to cases in which the symptoms pointed to lesions of the nervous system. In the second part he discussed the clinical pathology of the disease and the histological changes in the parotid gland. After summarising our previous knowledge of the etiology of mumps, he gave the results of experiments on monkeys with material taken from cases of mumps.

These experiments, although of only a preliminary nature, requiring confirmation and extension, are considered by Dr. Gordon "to seem to justify the view that in a proportion of cases of mumps a virus occurs in the saliva that passes through a Berkefeld filter, and is capable of producing in the monkey by intracerebral injection a lymphocytic meningitis together with a hyperæmia of the central nervous system and acute degenerative changes in a proportion of the neurons. Furthermore, if the animal lives long enough, acute interstitial parotitis may be produced."

In a Report on Ventilation and the effect of Open Air and Wind on the Respiratory Metabolism Professor Leonard Hill summarises the evidence collected from the researches of others and himself as to the causation of the discomfort felt in, and ill-health produced by, confined ill-ventilated places, and details his researches on the effect of open air and wind on the metabolism of man. He points out that the old views concerning the supposed poisonous nature of respiratory exhalations fail to be supported by scientific evidence. There is no evidence of the existence of any organic chemical poison in the exhaled air, and the alteration in the concentration of oxygen and carbonic acid such as occurs in ill-ventilated, crowded dwellings and places of business and amusement is not such as to cause any noteworthy physiological effect. The physical qualities of the air—the heat, moisture, movement—are of paramount importance to health.

Professor Hill concludes that the stimulating effect of cool and variable breezes acting upon the skin leads to vigour and health, while a stagnant, windless, over-warm atmosphere leads to depression and diminished vitality. The thermometer fails to show the atmospheric conditions suitable for human beings; what is required being an instrument which will give some measure of the rate of cooling of the body and the variability in this rate of cooling. Professor Hill describes two instruments—the kathermometer, invented by himself, and the caleometer, invented by Mr. O. W. Griffith and himself—which enable the rate of cooling and the variability of the rate to be measured.

The kathermometer was used by Professor Hill and Dr. Martin Flack in the investigation, an account of which is included in the report, on the effects of exposure to open air, wind, sea-air and sea-bathing on the respiratory metabolism. The readings obtained with this instrument demonstrate the greatly increased rate of cooling in open and sea-air compared with confined air, and give a measure of the bracing nature of the atmospheric conditions.

The results obtained in this research lead Professor Hill to conclude that the curative influence of open-air treatment and exercise depends on the increased metabolism of the body which is accompanied by a more ample ventilation of the lungs, more vigorous circulation, better appetite and digestion and lessened bacterial decomposition in the large bowel. He suggests that it is rather by these ways than by auto-inoculation that the beneficial effects are obtained in the treatment of phthisis. He urges that the movement of the air, producing an adequate

cooling of and stimulating effect on the skin, is the prime factor in ventilation, and that crowded tenements and cities owe their deleterious effects, to some extent at least, to the absence of movement of air and of sunlight, and not to chemical impurity of the air which is breathed. Of course, this does not imply that dust in respired air is harmless, especially if it carries with it specific germs of disease.

Two important reports were issued during the year* which form an addition to scientific knowledge of the character and source of tuberculous infection in children.

The work described in the first of these reports has occupied a large part of the time of Drs. Eastwood and F. Griffith in the Board's Pathological Laboratory during the latter half of 1912 and the year 1913. The object of the enquiry was to investigate the incidence of tuberculous infection in a series of children dying *from all causes* between the ages of two and ten years, and to determine whether in their bacteriological characteristics the bacilli found conformed to the "bovine" or the "human" type. The presence or absence of tubercle bacilli in the bronchial and mesenteric glands was ascertained, these glands being examined not only by dissection and microscope, but also by culture and biological tests, whether there was naked-eye evidence of tuberculosis or not.

In view of the importance of the subject, a parallel investigation was arranged at Cambridge. This was undertaken by Dr. A. S. Griffith. The main results of the two investigations are stated in combination in the following table:—

Series of 195 deaths from all causes of children between the ages of two and ten years.

Age Periods.	Number of Cases.			Classification of Cultures isolated.		
	Free from Tubercle bacilli.	Tubercle bacilli dead.	Tubercle bacilli living.	Bovine.	Human.	Mixed bovine and human.
2-3 years	27	1	19	6	13	—
3-4 "	12	2	21	4	17	—
4-5 "	14	4	14	1	13	—
5-6 "	12	3	15	—	14	1
6-7 "	1	3	16	3	13	—
7-8 "	3	2	2	—	2	—
8-9 "	4	2	4	1	3	—
9-10 "	4	3	7	2	5	—
Totals	77	20	98	17	80	1

* I.—The Incidence and Bacteriological Characteristics of Tuberculous Infection in Children; by Arthur Eastwood, M.D., and Fred Griffith, M.B. II.—An Enquiry, based on a series of Autopsies, into the Occurrence and Distribution of Tuberculous Infection in Children, and its Relation to the Bovine and the Human Types of Tubercle Bacilli respectively; by A. Stanley Griffith, M.D. (New Series No. 88.)

The first report deals with the examination of material from 150 children, and the second is primarily* concerned with material from 45 children; all these children had died in various hospitals, none of which were specially devoted to the treatment of tuberculous patients.

The incidence of tuberculous infection among these 195 children was 62·7 per cent. in the first series of 150, and 53·3 per cent. in the second series of 45 children (*see* Table on next page). Of the total 195 children, 118, or 60·5 per cent. showed evidence of tuberculous infection. The condition found in these 118 was as follows:—In 92 (47·2 per cent. of 195 or 78·0 per cent. of 118), tuberculous lesions, verified by subsequent cultures, were found; in six (3·1 per cent. of 195 or 5·1 per cent. of 118) living bacilli were obtained in culture, but there were no tuberculous lesions; and in 20 (10·3 per cent. of 195 or 16·9 per cent. of 118) tuberculous lesions were present, but the tubercle bacilli apparently were dead.

These statistics evidently do not justify a direct inference as to the extent of the incidence of tuberculous infection in the general juvenile population. They deal with a hospital population, affected by fatal disease, of some kind or other, or, in a few cases, by trauma. It has to be noted also that in some of the cases in which living tubercle bacilli were found there were no tuberculous lesions. Moreover, cases in which tuberculous lesions are discoverable are not necessarily associated with or followed by symptoms of tuberculous disease. At the same time the seriousness of the mortality directly attributable to tuberculosis is evinced by the fact that, in the first of the present series of cases, 61 out of the 94 children showing evidence of infection with tubercle bacilli had died from this disease.

Tuberculosis is a common cause of death in childhood, and the investigation shows that, apart from fatal cases of this disease, tuberculous lesions are common in sick children. It shows also that living tubercle bacilli may be present in their tissues apart from or in the absence of such lesions, and that tuberculous lesions may heal, inasmuch as the bacilli responsible for them may be dead.

The investigation was mainly concerned with the characters of the tubercle bacilli found in the lesions. Those strains were regarded as “bovine” which culturally and in their pathogenicity for rabbits resembled tubercle bacilli of bovine origin; and, in accordance with the usually accepted distinction between bovine and human types of tubercle bacilli, strains were regarded as “human” which differed from the bovine in their greater cultural luxuriance and in their lower pathogenicity for rabbits. One of the strains in the first series did not accord with either of these groups, but is classed as “bovine” from its cultural

* Dr. A. S. Griffith's list also includes 17 cases of ages less than 2 years, 3 cases of ages between 10 and 12 years, and 8 cases from institutions where tuberculous cases alone were available for his investigation, although these did not strictly come within the scope of the inquiry.

characters; and in one case in the second series bacilli both of the bovine and the human type were present.

—	1st series (Drs. Eastwood and F. Griffith).	2nd series (Dr A. S. Griffith).	Both series.	Percentages.		
				1st series.	2nd series.	Both series.
Total children dying from all causes	150	45	195	100	100	100
Number showing evidence of infection with tubercle bacilli	94	24	118	62·7	53·3	60·5
Of this number the tubercle bacilli were apparently dead but there were lesions in ...	16	4	20	10·7	8·9	10·3
Of this number lesions were present and tubercle bacilli were obtained in culture in...	73	19	92	48·7	42·2	47·2
Of this number no lesions were present but tubercle bacilli were obtained in culture in	5	1	6	3·3	2·2	3·1

In the first series, of the total 78 cases in which cultures of tubercle bacilli were obtained, 65, or 83·3 per cent. of this total yielded tubercle bacilli of the human type; and in the second series the corresponding percentage was 80 (*i.e.*, out of 20 cases yielding cultures, "human" strains were obtained in 16*).

Bovine bacilli were obtained, in the first series, in 13 cases, or 16·7 per cent. of the 78 yielding cultures; in the second series 5* cases yielded bovine bacilli, or 25 per cent. of the 20 yielding cultures.

—	1st series.	2nd series.	Both series.	Percentages.		
				1st series.	2nd series.	Both series.
Total children dying from all causes who yielded cultures of tubercle bacilli.	78	20	98	—	—	—
Bacilli of human type ...	65	16*	81*	83·3	80	82·7
Bacilli of bovine type ...	13	5†	18†	16·7	25	18·4

* Including one where "bovine" bacilli were also present.

† " " "human" " " "

* The case of mixed infection is counted twice.

Of the 98 cases comprised in the above table 17 showed bovine bacilli alone, and in 11 of these 17 death was directly attributable to tuberculosis.

The data contained in the two reports show that among the children carefully examined in this investigation, in which living tubercle bacilli were found, infection of human origin accounted for about five-sixths of the cases, while about one-sixth of them were of bovine origin. The reports give in exact detail the tests employed in determining the "human" or "bovine" character of the bacillus; and in accordance with the conclusions of the Royal Commission on Tuberculosis, it is assumed that the distinctions between the two types of bacilli have differential significance as to the human or animal source of infection.

These figures, while showing the greater importance of infection of human source, illustrate also the danger of cows' milk as a source of tuberculosis in childhood, and corroborate the conclusions upon this subject which were arrived at by the recent Royal Commission on Tuberculosis. In one important respect they supplement the work of that Commission, because they are based on material from an unselected series of deaths, whereas, as Dr. A. S. Griffith points out in his report, the material investigated for the Commission was selected, special attention being devoted to cases where the portal of entry of the bacillus was presumably alimentary.

The investigations show that, in the causation of human tuberculosis, infection both of human and of bovine origin has importance. Most of the material examined was derived from the metropolis. It illustrates, so far as this series of cases is concerned, the proportion of human and bovine infection by tuberculosis among children dying in London in hospitals other than those for tuberculosis. It is possible that in a subsequent series, and in series derived from sources other than hospitals, the amount of tuberculosis and the proportion between tuberculosis of human and of bovine source may differ materially; also that this amount and proportion will vary in different centres of population. This can only be determined in the light of further investigations on similar lines, and it is desirable that such investigations should be made.

It has already been indicated that in the report summarised above, children under two were omitted from examination. In some earlier German statistics facts had been stated for all children under ten years of age. Owing to the higher death-rate from all causes in the aggregate in infancy than in subsequent years such a series is liable to mislead, and the present series was therefore purposely limited to children who had survived the earlier dangers of childhood.

Although the investigations mentioned below were undertaken apart from the Auxiliary Scientific Grant of the Board it is convenient to summarise them in the present section of this report.

The Local Government Board issued in 1909 reports and papers on ferro-silicon with special reference to possible danger arising from its transport and storage. In these reports, which were presented to Parliament, it was shown that ferro-silicon of certain percentage compositions was liable to disintegration in the presence of moisture, and that poisonous gases were given off in quantity sufficient to produce fatal results in human beings. In my introduction to these reports attention was drawn to the suggestion made by Mr. Bennett and other observers that liability to spontaneous disintegration with evolution of poisonous gases was not improbably related to the amount of aluminium present in the ferro-silicon. During the year now under review the Board have issued similar reports on ferro-chrome and other ferro-alloys with special reference to aluminium content (Reports on Public Health and Medical Subjects, New Series No. 93), giving the results of further investigations previously authorised by the Board. Dr. H. Wilson Hake, Ph.D., reports on the examination of various ferro alloys with special reference to their aluminium content and its possible bearing on their stability and safety, and Mr. S. R. Bennett, M.A., one of H.M. Inspectors of Factories on the use of ferro-chrome in the manufacture of steel. These two reports have been issued with some introductory remarks by Dr. S. Monckton Copeman, F.R.S., and he summarises the results of Dr. Hake's investigations as follows:—

Ferro-chromes.—There would seem to be no doubt that an excess of aluminium in these alloys is coincident with a tendency to spontaneous disintegration, accompanied by evolution of phosphoretted hydrogen.

Ferro-silicons.—Although in most instances the aluminium found corresponds with the amount present in the coal used in the furnace charge, one sample which exhibited definite disintegration and evolution of poisonous gases was found to contain an exceptional amount of this metal. Arguing from analogy to ferro-chromes, however, it seems not unlikely that owing to reduction of aluminium in the electric furnace, and subsequent oxidation, the amount found in the final product may not appear excessive, although prior to such oxidation of the aluminium having taken place, the presence of the metal may have been responsible for a considerable reduction of calcium phosphate to phosphide.

Silico-Manganese.—Only two samples of this alloy were available for examination. Both were of a somewhat suspicious character, as regards tendency to disintegration and evolution of poisonous impurities, a fact suggestive of possible danger in connection with the transport, storage, and use of this material.

Ferro-Manganese.—Two samples examined showed only traces of impurities. As, however, cases of spontaneous disintegration of this alloy (to which I have directed attention earlier in this report) are known to have occurred, further knowledge on this point is needed.

Electro-Manganese.—The one sample examined contained 95 per cent. of metallic manganese and was free from impurities. But attention must be directed to the fact (not apparently previously recorded) that this product evolves hydrogen copiously when brought into contact with water even at ordinary temperatures, but especially if the latter be warm. In the event of hydrogen being thus generated during transport, especially on board ship, such an occurrence would be likely to give rise to considerable danger owing to the highly explosive nature of a mixture of this gas with air.

On pages 220 to 237 Dr. Blaxall contributes three reports on matters connected with the preparation and preservation of vaccine lymph. In the first of these he describes in detail the cold-storage plant installed at the Government lymph establishment, and shows that the experience of six years justifies the claims put forward in previous reports as to the value of this method of preservation. Glycerinated lymph has been stored at a temperature of -11° C. for two years and over, and its issue after that period has been attended with satisfactory results.

Particulars are given of 230 series issued between March, 1911, and September, 1913, which had been stored for 12 months and over at -11° C., the average age of the lymph at issue being 19 months. Employed for the vaccination of 247,767 cases these series gave a result of 99·3 per cent. case success, and 95·7 per cent. insertion success. Of these series, 51 had been in cold storage 24 to 27 months; these, used for the vaccination of 53,128 cases, gave a result of 99·4 per cent. case success, and 96·2 per cent. insertion success. Dr. Blaxall also discusses the question of exposure of the lymph to the ordinary every-day temperature after removal from cold storage. It is shown that in spite of the unusual heat in 1911 the lymph issued during that season gave results practically identical with those of the colder quarters of the year. From this it is inferred that the resistance of the lymph to the influence of outside temperatures is in no wise weakened by sojourn of the lymph in cold store.

Emphasis is laid on the need to keep lymph through all the operations arising out of its preparation and use at as low a temperature as possible, both before and after issue.

In a second report Dr. Blaxall states that oil of cloves, used as described in a previous paper, has been employed in routine manner in the preparation of lymph and has given excellent results. He writes: "By its action the extraneous organisms have been most markedly diminished, and in not a single instance has it appeared that the use of clove oil has acted prejudicially on the potency of the lymph." In order to ensure the full action of oil of cloves Dr. Blaxall lays stress on the need to produce a thoroughly intimate emulsion of the lymph, and describes the process he has adopted.

Further experiments have been made, using oil of cloves in greater proportion, as ·2 per cent. and ·3 per cent., and others using eugenol in strength of ·1 per cent. and ·25 per cent., but so far Dr. Blaxall does not find they show any advantage over the strength of ·1 per cent. oil of cloves which is the proportion originally recommended and to which he adheres.

In experiments with lanoline *plus* oil of cloves, Dr. Blaxall finds that the disinfectant action of clove oil on the extraneous organisms is nullified, apparently owing to the presence of fat, and this was also the case where olive oil was used instead of lanoline.

In his third report Dr. Blaxall details some experiments he has made to test the value of ether as an agent for the purification

of vaccine lymph after the method advocated by Dr. W. Fernet. He concludes from these experiments that though it may be possible by the use of ether to kill all the extraneous organisms before the whole of the specific potency is destroyed, yet the action on the potency is so severe that what remains is practically valueless.

I have the honour to be,

Sir,

Your obedient Servant,

ARTHUR NEWSHOLME.

November, 1914.

APPENDIX A., No. 1.

VACCINAL CONDITION OF CASES* OF SMALLPOX OCCURRING DURING 1913.

Ages.	A.		B.		C.		D.		E.	
	Vaccinated, as evidenced by presence of one or more vaccination cicatrices.	Fatal cases.	Stated to have been successfully vaccinated but no vaccination cicatrices present.	Fatal cases.	Stated to be unvaccinated (or vaccinated unsuccessfully) and no vaccination cicatrices present.	Fatal cases.	Previously unvaccinated, but vaccinated during incubation of small-pox.	Fatal cases.	Stated to have been successfully revaccinated†	Fatal cases.
Under 1 year	—	—	—	—	—	—	—	—	—	—
1—	—	—	—	—	1	—	—	—	—	—
2—	—	—	—	—	—	—	—	—	—	—
3—	—	—	—	—	1	—	—	—	—	—
4—	—	—	—	—	1	—	—	—	—	—
5—	2+	—	—	—	1	1	1	—	—	—
6—	1+	—	—	—	1	—	—	—	—	—
7—	1+	—	—	—	1	1	—	—	—	—
8—	1+	—	—	—	1	1	—	—	—	—
9—	—	—	—	—	—	—	—	—	—	—
10—	—	—	—	—	—	—	—	—	—	—
11—	1	—	—	—	2	—	1	—	—	—
12—	—	—	—	—	—	—	—	—	—	—
13—	—	—	—	—	1	—	1	—	—	—
14—	—	—	—	—	1	—	—	—	—	—
15—	3	—	1	—	9	—	—	—	—	—
20—	8	—	—	—	4	—	—	—	1	—
25—	6	—	—	—	2	1	—	—	2	—
30—	7	1	—	—	2	1	—	—	3	—
35—	4	—	—	—	—	—	—	—	1	1
40—	9	—	1	—	—	—	—	—	1	—
50—	3	—	—	—	—	—	—	—	—	—
60—	—	—	—	—	—	—	—	—	—	—
70—	—	—	—	—	—	—	—	—	—	—
80 years and upwards.	—	—	—	—	—	—	—	—	—	—
Total ..	46	1	2	—	28	5	3	—	8	1

* This table relates to 87 out of the 113 cases occurring during the year. Of the 26 not included in the above table, 25 are a separate class consisting of the persons notified from port sanitary districts. Three of these 25 cases were fatal. In these cases infection was contracted abroad, and most of those attacked were foreign or native seamen. The remaining case appears from the hospital notes to have been very doubtful, the "rash" being confined to one single spot.

† In the five cases in Class A which occurred among children under 10, the rash is described respectively as "very modified," "discrete modified," "modified" (2), and "discrete varioloid eruption."

‡ In the cases stated to have been successfully revaccinated, the interval since revaccination is given as 7, 10, 12 (2), 13, "about 13," "about 15," and 20 years respectively.

APPENDIX A., No. 2.

SUMMARY of information as to cases of POLIOMYELITIS and
CEREBRO-SPINAL FEVER notified during 1913; by
DR. R. J. REECE.

During the year 1913, poliomyelitis and cerebro-spinal fever were compulsorily notifiable throughout England and Wales. Inquiry has been made in each sanitary district in which cases have been notified, and by the courtesy of the several medical officers of health the information here given has been obtained. From a few districts no detailed information could be obtained. The period over which the inquiry related to is from the week ending 4th January, 1913, to the 3rd January, 1914. The numbers dealt with do not correspond with the published weekly notifications, inquiry having shown that some supposed cases were duplicate notifications; and other cases having been withdrawn owing to revision of the diagnosis.

The total number of cases of poliomyelitis and cerebro-spinal fever comprised in the following particulars are respectively 745 and 279.

The age and sex distribution and certain other particulars are given in a form corresponding with those in the last annual report of the medical officer of the Local Government Board.

As in the report for 1912 the fatality rate for the 1913 cases is probably fairly correct, and if there is an error it will be that the rate is slightly understated. A few cases have been lost sight of and particulars relating to their illnesses cannot be obtained. The available information is incorporated in Table I.

From Table I. it can be calculated that on the basis of notified cases the fatality rate for poliomyelitis was 14.1 per cent. and for cerebro-spinal fever 69.6 per cent. The fatality rates for poliomyelitis and cerebro-spinal fever for the year 1912 were respectively 13 per cent. and 70 per cent.

Also from Table I. it will be seen that the number of attacks was highest in the 1-5 age period, and the attack rate steadily diminishes in successive age periods.

TABLE I.—*Showing, for certain age periods, the age distribution, the number of deaths, and the number of cases which recovered at these age periods, of known cases of Acute Poliomyelitis and Cerebro-spinal Fever in England and Wales in the year 1913.*

Total number of cases dealt with.		Number of cases.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
		0-1 year.				1-5 years.				5-10 years.				10-15 years.				15-20 years.				20-30 years.				Over 30 years.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
		Male.		Female.		Male.		Female.		Male.		Female.		Male.		Female.		Male.		Female.		Male.		Female.		Male.		Female.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
Cases.	Deaths.	Permanent paralysis.*	Cases.	Deaths.	Permanent paralysis.*	Cases.	Deaths.	Permanent paralysis.*	Cases.	Deaths.	Permanent paralysis.*	Cases.	Deaths.	Permanent paralysis.*	Cases.	Deaths.	Permanent paralysis.*	Cases.	Deaths.	Permanent paralysis.*	Cases.	Deaths.	Permanent paralysis.*	Cases.	Deaths.	Permanent paralysis.*	Cases.	Deaths.	Permanent paralysis.*	Cases.	Deaths.	Permanent paralysis.*	Cases.	Deaths.	Permanent paralysis.*	Cases.	Deaths.	Permanent paralysis.*																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							

Number of cases removed to isolation hospital :—Acute poliomyelitis, 66; cerebro-spinal fever, 60.

* *I.e.*, recovered with permanent paralysis of one or more groups of muscles.

+ No information could be obtained in regard to the present condition of these patients.

NOTE.—745 cases of acute poliomyelitis were returned, but of 9 of these no particulars were obtainable.

279	"	cerebro-spinal fever	"	"	"	"
-----	---	----------------------	---	---	---	---

279 " cerebro-spinal fever

二

22

2

“

“

The proportion of attacks at each age period to the total attacks at all ages together with the number who died and the fatality at each age group are shown in the following table :—

TABLE II.—*Acute Poliomyelitis, 736 Cases.*

Age group.			Males.		Females.		Total.		Percentage of total cases occurring at each age period.	Fatality per 100 cases.
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.		
0-1	...	...	33	7	26	5	59	12	8.0	67.1
1-5	...	...	240	21	195	21	435	42	59.1	
5-10	...	...	83	14	70	12	153	26	20.8	17.0
10-15	...	...	22	4	23	6	45	10	6.1	22.2
15-20	...	...	16	4	5	1	21	5	2.9	23.8
20-30	...	...	8	4	6	4	14	8	1.9	57.1
30+	...	...	8	3	1	—	9	3	1.2	33.3
All ages	...	...	410	57	326	49	736	106	100.0	14.4

The number of cases which suffered permanent paralysis and the percentage of these sufferers at each age group are shown in the table below.

TABLE III.—*Acute Poliomyelitis.*

Age group.			Males.	Females.	Total.	Percentage of cases at each age group which recovered with permanent paralysis.
0-1	...	...	17	11	28	47.5
1-5	...	...	136	114	250	57.5
5-10	...	...	48	33	81	52.9
10-15	...	...	10	10	20	44.4
15-20	...	...	8	2	10	47.6
20-30	...	...	2	1	3	21.4
30+	...	...	2	—	2	22.2
All ages	...	...	223	171	394	53.5

Of the total number of 736 cases, 14 have been lost sight of, and information concerning their present condition is not available. Of the 722 remaining, 394 recovered with permanent paralysis of one or more groups of muscles, and on the total number of 736 the percentage of those thus affected is 53.5. This percentage is slightly higher than the corresponding rate, 51.9, in 1912; but in the year 1913 there were fewer cases concerning which information could not be obtained.

So far as it has been possible to obtain information it will be seen that of the 736 cases 394 or 53.5 per cent. recovered with permanent paralysis of one or more groups of muscles and 106 cases or 14.4 per cent. were fatal. The disease has thus killed or incapacitated in greater or less degree 68 per cent. of those who have been attacked by it.

Of the 736 cases of acute poliomyelitis only 66, and of the 276 cases of cerebro-spinal fever only 60 were removed to isolation hospitals for treatment.

In the following tables (Tables IV. and V.) are given data for the cases of cerebro-spinal fever :—

TABLE IV.—*Cerebro-spinal Fever.*

Age group.	Males.		Females.		Total.		Percentage of cases in age groups.	Fatality per 100 cases.
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.		
0-1	26	17	16	13	42	30	15·2	} 43·1
1-5	44	29	33	20	77	49	27·9	
5-10	35	25	23	14	58	39	21·0	67·2
10-15	21	13	18	14	39	27	14·1	69·2
15-20	12	10	9	8	21	18	7·6	85·7
20-30	8	4	12	10	20	14	7·3	70·0
30+	8	7	11	8	19	15	6·9	78·9
All ages ...	154	105	122	87	276	192	100·0	69·6

The number of cases which recovered with permanent paralysis in the 276 cases is as follows :—

TABLE V.—*Cerebro-spinal Fever.*

Age group.	Males.	Females.	Total.	Percentage of cases at each age group which recovered with permanent paralysis
0-1	—	—	—	—
1-5	2	2	4	5·2
5-10	2	1	3	5·2
10-15	3	1	4	10·3
15-20	—	—	—	—
20-30	—	—	—	—
30+	—	—	—	—

As the rates are calculated on small numbers they have but little value. But the rates bear a close resemblance to the corresponding rates for the year 1912. The resulting paralysis is insignificant in comparison with the proportion of permanent paralysis in the cases of poliomyelitis, while the fatality from cerebro-spinal fever was much greater than that from poliomyelitis in both years.

APPENDIX A., No. 3.

ABSTRACT of a REPORT by Dr. W. W. E. FLETCHER on an outbreak of SCARLET FEVER, attributed to MILK, in WOODBRIDGE RURAL DISTRICT in 1913.

Dr. Fletcher's report of this outbreak related to 76 cases of scarlet fever which occurred in four parishes (Trimley St. Mary, Trimley St. Martin, Kirton and Falkenham—total population about 2,200) in April and May, 1913, the bulk of them occurring during 13 days. April 24th to May 6th, during which period 41 dwellings were invaded and 58 cases occurred. The epidemic was of a relatively severe type as seven of the cases were fatal.

There had been three known antecedent cases of scarlet fever in Trimley in January and February which are to be referred to infection brought by a sailor coming home from Devonport. In certain houses in Trimley where scarlet fever occurred in April and May the families affected were associated closely by family relationship and otherwise with the people in whose houses the January and February cases had occurred, and had the infection been limited to this part of Trimley a recrudescence of local personal infection might have explained matters. The outbreak, however, was too sudden and too widespread for such an explanation, or indeed for any based alone on person-to-person infection, to be valid.

The number of houses invaded and the number of cases, together with other particulars, in each of the four parishes involved is given below.

—					Houses.*	Invasions.	Inmates.*	Cases.
Falkenham	...	...	...	...	62	1	238	1
Kirton	...	...	...	...	122	4	500	4
Trimley St. Martin	...	...	...	...	190	45	781	75
Trimley St. Mary	...	...	...	...	193		758	

				House invasion rate	Attack rate on population
Falkenham	...	...		= 1.6 per cent	= 0.4 per cent.
Kirton	...	...		= 3.3 „	= 0.8 „
The two Trimleys	...	...		= 11.7 „	= 4.9 „

The two Trimleys are classed together, because the populous parts of the two parishes form one long continuous village.

The character of the outbreak is indicated in the following table and chart :—

Weeks ended					Houses invaded.	Patients attacked.
February	1st	...	..	...	1	1
„	8th	...	...	...	—	1
„	15th	...	...	...	1	1
April	26th	...	...	...	7	8

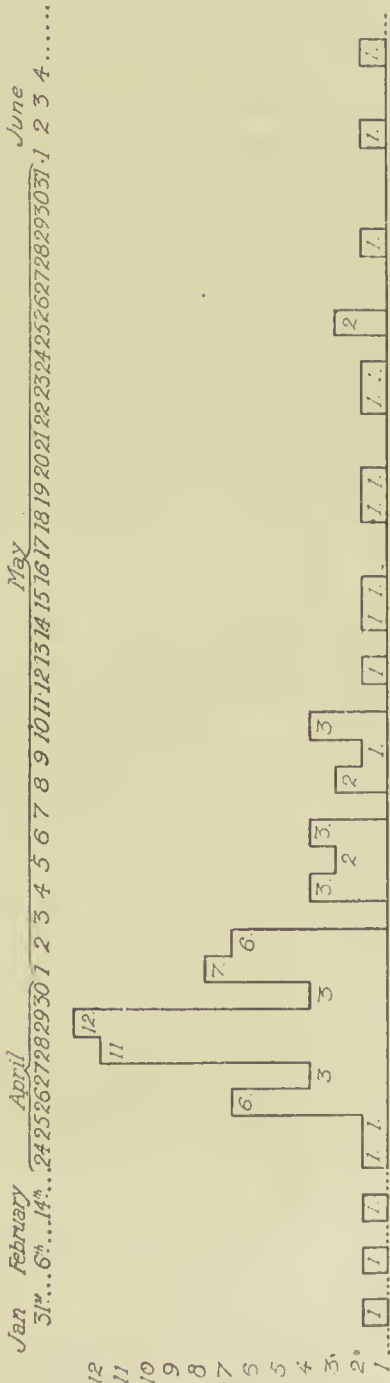
* Census returns, 1911.

SCARLET FEVER IN WOODBRIDGE RURAL DISTRICT, 1913.

Chart showing dates of invasion of 50 dwellings.



Chart showing dates of attack of 79 patients.



	Weeks ended				Houses invaded.	Patients attacked.
May	3rd	...	...	...	31	42
"	10th	...	...	...	8	14
"	17th	...	...	...	1	3
"	24th	...	...	...	—	4
"	31st	...	...	...	1	3
June	7th	...	...	...	—	2
	Totals	...	...	...	50	79*

* The eightieth case was a secondary case notified on July 5th, but the date of attack was not given.

Two houses were invaded in January and February, while 46 were invaded in the 17 days, April 24th to May 10th, one on May 14th, and one on May 25th. As to cases, three occurred in January and February, 64 on the 17 days quoted above, and 13 subsequently, of which all but two were secondary cases.

Ignoring the three January and February cases, all of whom were females over school age, there are left 77 patients, of whom the ages and sexes are shown below.

—				0—	4—	15—	20—	30 and over.	Totals.
Males ...	...	...	...	4	13	4	4	0	25
Females	...	...	..	6	25	6	12	3	52
Totals				10	38	10	16	3	77

Drs. Hollis and Stewart, medical officers of health for the district and for East Suffolk county respectively, were early on the spot, and made prompt enquiry into the cause of the outbreak. The invaded houses were situated mainly along the highway running through the two Trimleys and in its immediate vicinity, but there were other invaded houses scattered about at considerable distances from the two Trimley villages, and from each other. Discarding school infection, as investigation in this direction failed to produce evidence incriminating the schools, only one circumstance was common to all the houses invaded from April 24th to May 4th, 41 in number, viz., a common milk supply; indeed, up to the end of the outbreak there were only four houses, out of 48 invaded in April and May, which did not receive some milk from this supply. Moreover, the man who did the "round" served milk only in the four invaded parishes; and he served houses, some of which were invaded, in Trimley on the border of Felixstowe Urban District, but none over the border, and not a single house over the border was invaded.

The milk which first fell under suspicion was that distributed locally by Mr. X, residing at No. 1 farm in Trimley St. Mary's. This farm was inspected and nothing was found wrong with cows, premises, workers or procedure; but it was elicited that the milk distributed locally was a mixture of milk from No. 1 farm and milk from another farm, "No. 3," and it appeared that the milk supply of No. 3 farm, distributed either unmixed or mixed with milk from other farms, was in all probability responsible for the outbreak. This conclusion was drawn from the circumstantial evidence obtained as to the milk supply generally, the distribution of milk from different farms, and the milk used at the houses at which scarlet fever appeared. Investigation showed, for example, that approximately half of all the houses in the parishes involved were supplied with milk by Mr. X, while of the 48 dwellings invaded during the April and May outbreak no less than 44 received this milk: the remaining four dwellings had milk from three other sources. Moreover, the age and sex distribution, the suddenness of the onset and the topography of the epidemic were by themselves suggestive of milk infection.

The origin of the infection of milk at No. 3 farm during the period in question remains in doubt, notwithstanding much effort to elucidate it.

About six days before the beginning of the outbreak two London children who had lately arrived at No. 3 farm developed sore throats, and Dr. Fletcher obtained evidence that at their London home an infective sore throat illness of some kind had occurred, both the mother and a brother of the children having had sore throats shortly after the children themselves had gone to Trimley. It has not been shown, however, that this sore throat illness was definitely scarlet fever, nor has any suggestion been obtained of any way in which these children would have had opportunities of infecting the milk. The only illness among the milkers was a case of scarlet fever in a cowman, a consumer of milk from No. 3 farm, which occurred coincidently with, not antecedently to, the outbreak. There was a story of an ailing cow which had aborted some time before the outbreak, but the inquiries indicated that the milk of this cow was not going into the supply.

The supply of milk from No. 3 farm was stopped on May 6th and only five cases occurred after that date. Dr. Fletcher lays stress on Mr. X's willingness to do all that was necessary in the matter.

APPENDIX A, No. 4.

DR. E. P. MANBY'S REPORT upon an outbreak of ENTERIC FEVER in the URBAN DISTRICT OF KENILWORTH.

The first intimation the Board had of the recent outbreak of enteric fever at Kenilworth was contained in a special report—in the form of a letter—from Dr. C. E. Tangye, the medical officer of health, received on December 18th, 1913. Dr. Tangye stated that when he wrote on December 16th there were 20 cases of enteric fever in Kenilworth, that the infection was probably due to pollution of the local water supply, but that the matter was complicated by the presence of a number of cases of acute gastro-enteritis, some of whom had drunk the water and some of whom had not. Information was also given as to the steps which were being taken to cope with the outbreak, and a copy was enclosed of a "warning notice" which had been issued with regard to the necessity for all water being boiled prior to use for purposes of drinking, washing of food and food utensils, etc.

I received instructions, in Manchester on December 18th, to proceed to Kenilworth without delay, and I did this on December 19th. I visited Kenilworth again on December 22nd, and on subsequent dates. Mr. J. B. Hill, the Board's geological adviser, accompanied me on my visit on January 5th, 1914.

GENERAL DESCRIPTION OF KENILWORTH AND ITS SANITARY CIRCUMSTANCES.

The Urban District of Kenilworth is situated in Warwickshire about midway between Leamington and Coventry. *The area* of the district is 5,914 acres. *The population* at the census of 1911 was 5,776, and the number of families or separate occupiers then was 1,420. The present population is estimated to be 5,990.

The town is largely a residential one, and contains but little poor class property.

The geology of the district is represented by a succession of red sandy and marly beds of the upper coal measures overlain by discontinuous patches of glacial sands and gravels.

The town is *sewered* throughout its urban portion, and all houses in the district, except 149 outlying ones, are connected with the sewers.

Surface drainage from roadways passes for the most part into old rubble drains, and into water-courses. All road and yard gulleys are stated to be trapped. It is believed that a few houses still drain into the rubble drains and water-courses. These are dealt with when discovered.

The main sewerage system was established out of loan sanctioned by the Board in 1880. Since then extensions have been made, and a modern sewage disposal works was substituted in 1905-6 for that originally in use. The main sewers are indicated on the map accompanying this report.

The total length of sewers in the urban district is 9 miles, 6 furlongs, 104 yards. The sewers are mostly of stoneware pipes, but there are a few lengths of cast iron and of wrought iron pipe. The sewers are provided with the usual man-holes and lamp-holes, but the covers of these are sealed, and ventilation is afforded by means of shafts, 27 in number. The diameter of the sewers varies from 6 in. to 18 in.

The gradients of the sewers are flat in parts, and this is especially so in the neighbourhood of the Washbrook bridge where the blockage to be subsequently referred to took place. For a short distance hereabouts the fall is as slight as 1—2320.

The sewers are flushed thrice weekly throughout the year. Flushing chambers with taps are provided to all sewers but one.

Storm water overflows exist at three points, which are shown on the map. The one marked (S) discharges into the Finham brook above the site of the waterworks, the others enter this brook below the works.

The houses in Kenilworth are nearly all fitted with water-closets, and all of these but 129 have flushing cisterns. House drains are as a rule intercepted before entering the sewers.

Scavenging of refuse is undertaken by the Council in the urban part of the district. Most of the houses have sanitary dustbins for the reception of domestic refuse.

The town is traversed from west to east by the Finham brook just referred to. No doubt at one time this brook received most of the sewage of the town, and, as I have just stated, it is believed that a few houses still drain into it through the medium of old rubble drains which exist and receive road-washings, etc.

The brook runs further risk of pollution by reason of the facts that (a) water used for sheep washing passes into it; (b) the water from the public baths is discharged into it; (c) it is traversed by three fords; and (d) drainage from a number of pig-sties in School Lane probably finds its way into it. In addition there are (e) a number of farms abutting on the brook above Kenilworth, and it is probable that directly or indirectly sewage from them reaches this stream; and (f) the three storm water outfalls from the sewers already referred to.

A *public water supply* for Kenilworth is afforded by the Kenilworth Water Company, whose mains serve, I am informed, 1,274 houses comprising a population of 5,258 persons.

There are about a dozen private wells used for supplying drinking water in the urban part of the district, and many more exist in the rural part.

A plan of the Kenilworth Water Company's works is annexed to this report.

The works, about half an acre in extent, are situated in a valley. They are bounded on the south by the Finham brook and on the north by Kenilworth Common. The site rests upon the upper

coal measures, neither glacial deposits nor river alluvia being present.

The sources of water supply are two deep bore wells and an adit. The water is not subjected to filtration. There is a compensation tank of a capacity of 24,000 gallons upon a tower at Tainters Hill, but much water is pumped directly into the mains. The older bore-well, which was sunk in 1894, is 226 ft. 6 in. deep. It is 10 in. in diameter for a depth of 72 ft., and below that is 6 in. in diameter. It is lined with a single steel tube which is imperforate laterally until 72 ft. below the ground level, but perforate below that level. The newer bore-well was sunk in 1909. It is 265 ft. deep. The diameter to a depth of 100 ft. is $13\frac{1}{2}$ in., then $11\frac{1}{2}$ in. to 200 ft. and 10 in. for the remainder of the depth. The bore is lined by double steel tubes which are imperforate laterally for the first 100 ft. Mr. Hill reports that the strata through which the bores pass is an admixture of sandstone and fine sandy marls. The percolation through the latter is so extremely slow as to ensure a high degree of filtration before reaching the level of the perforated tubes.

The adit was constructed in 1884. It is thought to be about 300 ft. long, and it runs roughly parallel to the course of the Finham brook, at a distance of about 5 ft. from it at the west end and 30 ft. at the east end. These figures are only approximate as the company have no plan showing the exact position and size of the adit. The Kenilworth Water Company stated in the official return to the Local Government Board which was required from all water undertakers in 1911 that the adit was 60 ft. long and 20 ft. below the ground level. As the position of the adit has not been altered, nor its length added to since that year, this statement was certainly inaccurate. The height of the adit is about 6 ft. Its crown is about 10 ft. and its floor about 16 ft. below the surface of the ground above. The lower 5 ft. or thereabouts of the adit are below the bed of the brook, and there is an overflow from the top of the adit, at its eastern end, into the brook, about 1 ft. above the bed. The outlet is closed by a flap cover which, if not approximated accurately, might upon occasion admit water from the brook to the adit; and there is a stop-cock within the curtilage of the water works by which the outlet could be completely cut off from the brook. This special stop-cock is used but seldom, and according to the engineer's statement to me on January 5th, 1914, had certainly not been closed for a year. It was, therefore, open when the heavy rainfall and sewer blocking, to be subsequently referred to, took place in November, 1913. The following notes by Mr. Hill, the Board's geological adviser, may be inserted here:—

“The adit is excavated in sandstone and is said to rest on a bed of clay. The sandstone bed in question is exposed in the stream below the western edge of the waterworks.

“The adit is not connected with either of the wells. It is obvious that it is liable to receive water from the stream by percolation through the sandstone, and that the distance is too small to admit of efficient filtration.

“The stream is on the south side of the adit, and the bulk of the water which reaches the latter is obtained from the subsoil

“ drainage of the slopes on the north side, and it is only when this supply fails, or is insufficient in volume to meet the demands of pumping, that water is likely to be drawn in from the stream. Such conditions, however, must frequently occur.

“ The danger of contamination from the proximity of the river or from subsoil drainage to which the water in the adit is exposed does not exist in the case of the deep-bore wells. The depth of these wells is very great, and the strata through which they pass is not fissured, so that assuming that they are adequately protected by their linings to a sufficient depth, there is practically no risk of polluted water gaining access to them.”

Contamination of the water in the adit would be possible by percolation from the stream through the intervening soil, by direct access of stream water through the overflow, or by contamination of the ground water from which the springs supplying the adit are drawn. In addition to this the adit is provided with a manhole and steps, and contamination might take place through the manhole, or from the feet or person of anyone descending the steps. The closet provided for the staff of the waterworks is a pail which in the process of emptying is carried either to the common or to the allotment of one of the workmen. The latter is the more usual means of disposal, but in either case if the manhole happened to be open filth might gain access to the adit if the pail were carried near it, as it could hardly fail to be—see plan of the site.

Lastly, no urinal exists on the waterworks premises, and while it is unlikely that urine would gain access to the adit except in the manner suggested above, the possibility of such access must be remembered.

The adit was regarded by the water company as their main source of supply. For ten years it was the only source of supply. Eight thousand gallons of water can be pumped per hour from the adit, and 4,000 from each of the bore-wells. I was informed by the engineer that the new bore-well had not been pumped from for three months prior to December 3rd, as there was so much water in the adit, but that the old bore was always used daily with the adit, and solely at night, 4,000 gallons per hour being then sufficient for the needs of the town.

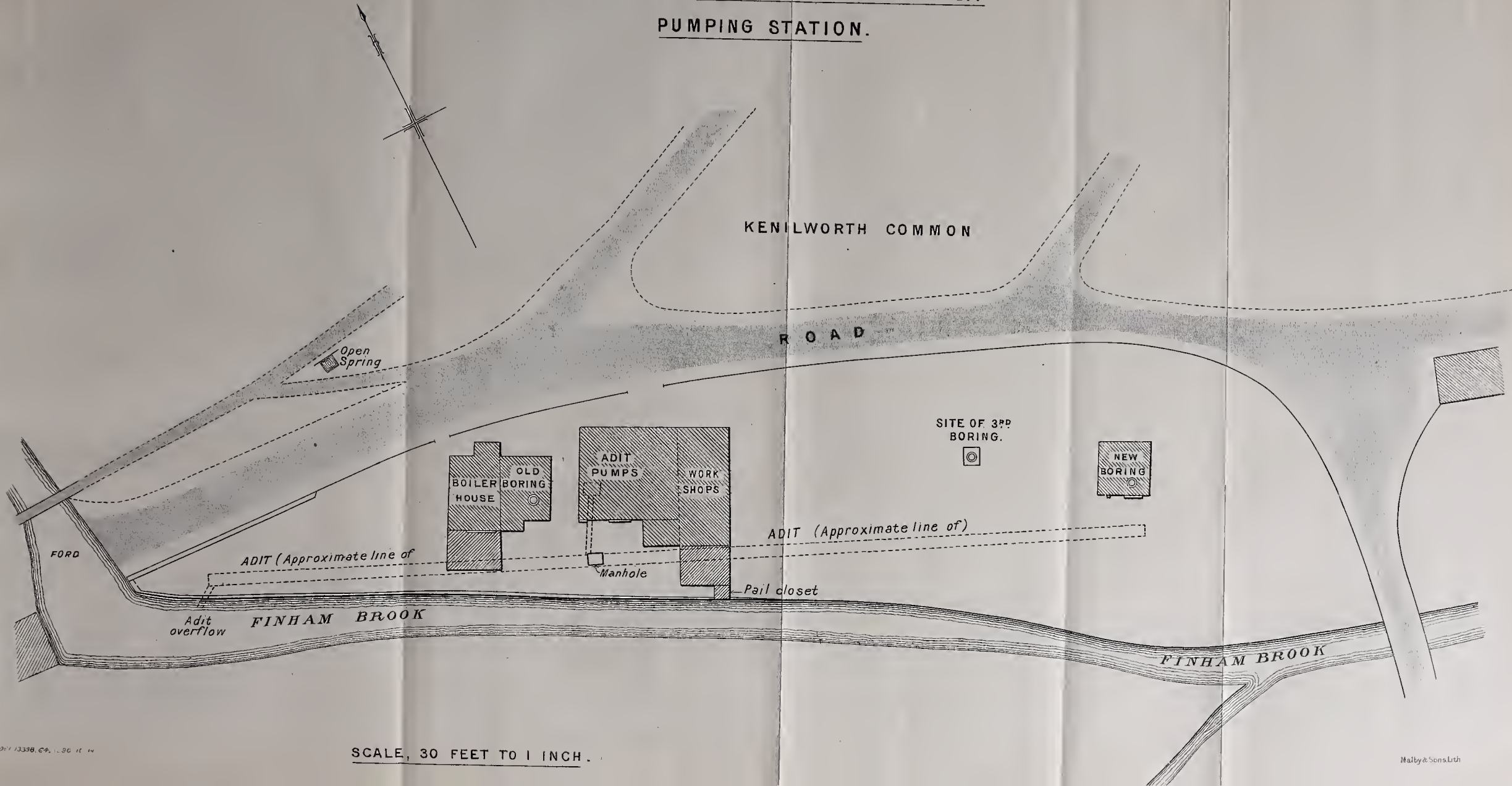
The Kenilworth Water Order, 1882, was obtained from Parliament by two undertakers, Messrs. Lundie and Floyd, Civil Engineers. These gentlemen transferred their rights to the Kenilworth Water Company for £550 in July, 1883. In 1884 the company commenced the construction of the adit. I was informed by a son of the late contractor for the work that an open trench was dug, this was arched over with brick which was then covered with earth to the level of the surrounding ground.

I think the term “adit” is reserved usually for a heading driven underground, and that whether or not this is a true adit it cannot be called a “well” in the ordinary acceptance of that term. The word “well,” however, is the term used in the Kenilworth Water Order, 1882, authorising the undertaking.

Analysis of the public water supply has been undertaken at the expense of the urban council at infrequent intervals, and the

KENILWORTH WATER COMPANY LTD.

PUMPING STATION.



water company informed me that they had analyses made at intervals of a year or two. In each instance chemical analyses only were made. The directors of the company informed me that they exchanged analyses with the urban council, but the medical officer of health and the inspector of nuisances stated that they had never seen, until the recent outbreak, any analyses made at the expense of the company, and that as far as they know no analyses made at the expense of the urban council were forwarded to the company. The clerk to the urban district council also informed me that he had no knowledge of the reciprocal arrangement referred to.

The water company have furnished me with copies of analyses made for them during the past three years. These are dated March 11th, 1909, April 1st, 1911, and August 14th, 1913.

The report accompanying the 1909 analysis states that the figures for free ammonia show a larger amount (0.003 per 100,000) than would be given by an ideal water; but the water was stated to be "quite fit for drinking purposes." Apparently correspondence ensued, for on March 25th, 1909, the analysts, Messrs. Wyleys, wrote to the water company "that the water was quite a good water and free from organic impurities. At the same time we should not describe it as 'excellent,' nor quite equal to some of the waters obtained from some artesian wells in this district."

The sample analysed on April 1st, 1911, by Messrs. Southall was stated to contain "faintest traces of lead."* In that analysed in August, 1913, by Messrs. Wyleys, there is no mention of lead, and the amount of free ammonia was only 0.005 per million.

I may add, as evidence that the liability of the adit water to risk of contamination has in the past been considered by the water company, that in the spring of 1912 the company asked the urban district council to extend a sewer from Lower Ladies Hill in order to take the drainage from Crackley Hall and from two cottages near by, as they feared the possible contamination of the adit water by sewage percolating through or over the adjacent common, which is at a higher level than the waterworks.

It is to be regretted that it has not been the practice to submit the water for bacteriological examination as well as for chemical analysis. Complete analysis in both respects must be regarded as indispensable in the case of a public water supply of this nature.

It might be mentioned here that in his annual report for 1911 Dr. Bostock Hill, the county medical officer of health for Warwickshire, emphasised the importance of periodical bacteriological and chemical analyses of all public water supplies. In the following October (1912) the Clerk to the Warwickshire County Council sent to all borough and district councils in the county a print of the report, and drew special attention to the

* The presence of lead when tested for in the 1911 sample is perhaps an indication that at that time the water used was almost entirely from the adit, as water derived from the river might be more likely than deep well water to act on lead.

paragraph containing the advice referred to. Apparently no action was taken by the Kenilworth Council on this letter.

HISTORY OF THE ENTERIC FEVER OUTBREAK.

Prior to October 18th, 1913, there had been but one case of enteric fever notified in Kenilworth that year, viz., in February. The patient was an errand boy whose case appears to have no relation to the present outbreak. There was no case notified in 1912.

The patient notified on October 18th, 1913, was a young lady, H—, aged sixteen. She sickened about October 2nd, but repeated inquiry failed to discover definitely the origin of her infection. There was a history of Miss H— having eaten water-cress from a doubtful source about September 27th, but this food, if infected, would be unlikely to have given rise to symptoms of enteric fever as early as October 2nd.

The second case was N—, a man aged forty-three, notified on November 22nd. He worked at Coventry, and was away from work on October 21st and 25th with headache and pain in the back, which were considered to be influenza. He then returned to work, but felt unwell again on November 10th, and did not go back to work after November 12th. It is possible that the date of onset of this man's enteric fever was October 21st and not November 10th, but this cannot, of course, be determined now. The patient had no connection with the case notified on October 18th. It is possible that N— contracted infection in Coventry, or on his journeys there and back, but no definite history of infection in this way, or in Kenilworth, could be obtained.

The third case reported was that of a woman, B—, aged 29, who was notified as having enteric fever on November 27th. She had been ill since October 12th with what appeared to be influenza, and was admitted to the Warneford Hospital at Leamington on November 16th. At that time she was considered by the hospital staff to be at the end of the third week of enteric fever, in which event the onset of the disease would have been about October 26th, and infection would have taken place about October 12th. If, however, the influenzal attack was really the beginning of enteric fever, then it must be assumed that B— was infected about September 28th, and that the condition for which she was admitted to the hospital was a relapse of enteric fever.

Here again repeated enquiry failed to elicit any definite source of infection. There was no contact discoverable between this case and that of H— nor of N—. There was a history of complaints of smells from a gulley opposite the house in which B— lived, and some months previously the drainage of the w.c. of this house had been found to be defective and was repaired.

Inquiry revealed the fact that B—'s husband was ill with what was considered to be influenza about the same time as B—. He appeared to be perfectly well when I saw him, but a Widal test of his blood gave positive result. It was then learnt that he had a severe attack of enteric fever in India in 1907 when he was serving in the army. Specimens of this man's urine and faeces

were obtained and submitted to bacteriological examination with a view to ascertain if he were a chronic "carrier" of enteric fever infection, but the results were negative. He worked at Coventry prior to his illness in October, 1913, and if we assume, as is not unusual in such cases, that he was an intermittent carrier, he may have infected both his wife and in some way not known N——, who also travelled to and from Coventry daily. This is, of course, an assumption, but the fact that the man's blood still reacts positively to Widal's test gives some support to the assumption.

While there was no contact or common infection by food to be made out between the three first cases, it should be noted that the first and third lived near to one another, and that their houses drained into the same sewer. N—— lived a considerable distance from the other cases, but his house drained into the Odiborne Close sewer. The bearing of this will appear later when the cause of the explosive outbreak is discussed.

The fourth case, W——, a girl aged eight, was notified on December 5th. Her illness appeared to have started on November 22nd. Here, again, no history of infection from a previous case could be traced, but I am inclined to regard this as the first case of the explosive outbreak now to be described. The onset of one other case appears to have been as early as November 22nd, although he was not notified until December 19th.

Subsequent notifications were received as under:—

2 notifications on December 13th, 1913.				
1	notification	„	„	14th „
1	„	„	„	15th „
11	notifications	„	„	16th „
*2	„	„	„	17th „
†3	„	„	„	18th „
3	„	„	„	19th „
5	„	„	„	20th „
4	„	„	„	22nd „
1	notification	„	„	23rd „
1	„	„	„	24th „
2	notifications	„	„	27th „
1	notification	„	„	30th „
1	„	„	January	3rd, 1914.
†1	„	„	„	8th „
1	„	„	„	10th „
1	„	„	„	13th „

As the date of notification of a case of enteric fever is but an inaccurate indication of the date of the onset of the disease, direct inquiry as to these dates was made in each instance. The results have been plotted on the diagram annexed to the report. This shows that after H——, B——, and N——, the further cases, 41 in number, sickened between November 22nd and December 25th, and that no fewer than twenty-six of these fell ill with

* One subsequently withdrawn as not enteric.

† One of these cases contracted infection in Kenilworth, but was notified from Hampton-in-Arden. He is, however, included as a Kenilworth case in this report.

‡ Ill since November 24th, 1913.

the disease between December 5th and 12th, the greatest number occurring on one day being six on December 7th. One of the cases of December 23rd undoubtedly contracted infection from a previous case. She was notified on January 3rd.

There was some doubt whether the onset of the cases notified on January 10th and 13th should not have been placed a week earlier than December 25th and 23rd respectively.

Excluding the case subsequently cancelled the total number of notifications was forty-four.

There were four deaths.

The subjoined table of age and sex incidence shows that the sufferers were not markedly more of one age or sex than of the other. As a fact there were in each age period approximately equal attacks on each sex.

TABLE OF AGE AND SEX INCIDENCE.

				0-	5-	10-	15-	25-	35-	45 and up- wards	Total.
Males	...	...	...	0	4	3	9	2	2	3	23
Females	...	...	...	0	4	2	11	2	1	1	21
Total ...	...	...	...	0	8	5	20	4	3	4	44

HISTORY OF THE OUTBREAK OF GASTRO-ENTERITIS.

A very extensive amount of gastro-enteritis prevailed in Kenilworth between the middle of November and early December. I think a general consensus of opinion is that by far the greatest number of cases occurred between November 19th and 26th. Several of the sufferers from enteric fever appear to have been attacked by gastro-enteritis previously, and too long beforehand for the condition to be merely symptomatic of commencing enteric fever.

It is quite impossible to estimate the proportion of the population of Kenilworth which was attacked by gastro-enteritis. Some residents, both medical and lay, suggested that it was as high as 50 per cent., and most people agreed that very few households escaped attack altogether. Many persons were not sufficiently ill to consult a medical man at all. But some, including medical men, were for a time acutely ill with the disorder, and one doctor said he thought at first he must have been poisoned so severe was his illness. Dr. Tangye made inquiry at the local public elementary schools, and he was informed that at the largest school from 26 per cent. to 32 per cent. of the children had been reported as having suffered from the complaint. It is probable, therefore, that this proportion might not unfairly be taken to represent the proportion of people attacked throughout the town.

Locally the cause of this outbreak was attributed at the time to

contaminated drinking water, and it is interesting to note that outbreaks of enteric fever ascribed to polluted water have been reported of recent years in not a few places in England and America to have been preceded by prevalence of gastro-enteritis.

It is worthy of note that the bulk of the gastro-enteritis cases in Kenilworth appear to have occurred two or three days after the blockage of the sewer which, as will be presently detailed, was probably largely instrumental, associated with heavy rains, in bringing about the outbreak of enteric fever.

One must not, however, forget that influenza of a gastric type prevailed extensively in many parts of England last autumn, and that the association of the outbreaks at Kenilworth of enteric fever and gastro-enteritis may have been merely a coincidence. Further, while a number of persons who did not reside in Kenilworth appeared to have contracted a gastro-enteritic infection there, possibly by drinking water while in the town, a number of other persons who had not visited Kenilworth, and had no connection with Kenilworth water, did in fact suffer from gastro-enteritis about the time that this complaint was prevalent there. I found this notably in Stoneleigh and other places near by, and Dr. Tangye made inquiry as to the prevalence in yet other places, *e.g.*, Solihull, Leek Wootton, Rugby, etc. There were, moreover, a certain number of persons attacked with gastro-enteritis in Kenilworth who stated that they did not under any circumstances drink unboiled water. Some persons were met with who were accustomed to drink large quantities of unboiled water, but who did not suffer from gastro-enteritis. I think, however, that the outbreak was distinctly more "explosive" in character in Kenilworth than it was in the outlying places, and it is probable that the contaminated public water supply in Kenilworth was responsible for a number of the cases of gastro-enteritis.

In view of the possibility of the sufferers from gastro-enteritis having been infected with the para-typhoid bacillus, or with some organism of the *B. Coli* group, specimens of blood from a number of persons were sent to the University of Birmingham for bacteriological examination. The results obtained were unconvincing, and are not reproduced here. It would have been interesting if specimens of blood and of dejecta from some of the gastro-enteritis patients had been examined at the time of illness, but in the early stages of the outbreak the medical officer of health had not been made aware of the prevalence of the disorder, and later on he was too fully occupied in dealing with the enteric fever to be able to deal with this matter.

CAUSATION OF THE OUTBREAK OF ENTERIC FEVER.

In considering the probable causation of any outbreak of infectious disease, regard must be paid to the dates of onset of illness rather than to the dates of notification of cases. But in the present instance information arrived at in either of these ways pointed to the same conclusion, *viz.*, that the outbreak was "explosive" in character. A few cases occurred before a certain short period, a few cases occurred after that period, but the bulk of the cases occurred within that period. Such an explosive out-

break of enteric fever is unlikely to arise from person to person infection. It predicates the contamination of some article of food or drink which is consumed by a large number of people, and in the majority of instances the article is milk or water.

In the present outbreak enquiry was made in all cases as to the source of the milk and of the water consumed by the enteric fever patients, and in addition the possibilities of infection by means of contaminated shell-fish, brawn, mineral waters, and other foods and drinks were investigated.

The milk consumed by the sufferers from enteric fever was supplied by thirteen milk sellers in Kenilworth. Broadly speaking those doing the largest business supplied the most sufferers. and the percentage of invaded houses to total customers, and of milk purchased for these households to total milk sold, showed at once that the relationships were not abnormal, and that the cause of the outbreak could not be ascribed to contaminated milk. There was in fact no evidence that any article of food or drink except water had played any part in the spread of the fever. I have already referred to the possibility of the first known case having been infected by watercress, but the evidence of this was not convincing.

All classes of society were attacked, and the cases occurred in all parts of the town. This in itself constitutes a strong argument in favour of a water-borne outbreak—especially when it is added that each invaded house was supplied with water from the public supply and in no other way, also that several of the sufferers were large water drinkers, and that others of them made a practice of taking draughts of cold water on rising in the morning.

The incidence was not notably confined to one sex, nor to any special age period. This again points to a commodity like water, consumed by all, as the distributing agent of the infection. The balance of evidence, therefore, from the epidemiological aspect pointed to contamination of the public water supply as the causal factor in the outbreak. A sewer in Odiborne Close was blocked on or before November 17th, 1913, and on that day, which was free from rain, the storm overflow from this sewer was running freely into the Finham brook by the Washbrook bridge. The sewer was unblocked early on November 18th by rodding between two manholes, but no definite obstruction was found.

The position of the adit at the waterworks in relation to the Finham brook, and the geological formation of the ground intervening between the adit and the brook, to say nothing of the overflow from the adit being closed only by a flap valve, indicated that there was every probability that if organic matter containing enteric fever infection gained access to the brook it would be drawn into the adit and so distributed to the consumers of the water.

Reference should now be made to the diagram facing page 12 of this report. That diagram shows all the cases plotted according to their approximate dates of onset, and also the rainfall of one-tenth of an inch and more which occurred during the months of October, November, and December, 1913. The date upon which the Odiborne Close sewer obstruction was removed, November 18th, is also shown on the diagram. It will be remembered that

the houses of the first cases of fever notified all drained into this sewer, and that infectious material was being discharged into the sewer during October and November.

No record of rainfall for Kenilworth existed, but records were available for Leamington, distant about 5 miles to the south, and for Coventry, a similar distance to the north-east. In plotting the rainfall for Kenilworth, I have taken it approximately as the mean of the rainfall of the other places named. The rainfall for October was very heavy at the beginning of the month, but was almost negligible after October 11th. Rain fell on five days, but only six-tenths of an inch fell altogether. In the early part of October there were cases of enteric fever in Kenilworth, but they were in the early stage, and even if any infectious material from their evacuations was washed into the Finham brook through the storm overflow of the sewer, the rainfall was so heavy that the infectious material would be greatly diluted. Moreover, at this time the sewer was not blocked so that most of the sewage would pass along it, and relatively little would get into the brook through the storm overflow. Heavy rain did not fall again until the beginning of the second week in November, when approximately 1.75 in. fell in the four days November 10th, 11th, 12th, and 13th. This was heavier but less prolonged than the early October rain, and it is fair to assume that again the infective material which was in the sewage was highly diluted when it escaped by the storm overflow.

On November 17th the sewer was noticed to be blocked, and had possibly been blocked for a day or two before it was noticed. By reason of this blockage undiluted sewage would flow into the brook through the storm overflow.

On November 18th the sewer was unblocked, and no doubt much infective material at once passed away down the sewer. But on November 20th and 21st rain fell to the extent of more than half an inch, which would again cause the storm overflow of the sewer to come into operation, and as the contents of the sewer had just been stirred up by the rodding operations undertaken to unblock the sewer, it is probable that the amount of infective material which escaped by the overflow was much larger than had been the case on the previous occasions, where, although sewage had escaped by the overflow, the deposit in the sewer had not been disturbed.

A further amount of rain to the extent of half an inch fell on December 4th. A small quantity of rain fell on November 30th, but except on December 4th there was very little rain again until December 26th.

Taking the period of incubation of enteric fever to be fourteen days as a rule, but bearing in mind that the period is occasionally shorter, and is often longer, the plotted diagram may now be examined with a view to ascertain when the various groups of cases may have been assumed to have become infected.

Four cases occurred on November 22nd-26th. Fourteen days prior to November 22nd was November 8th, which was not a day upon which any considerable quantity of rain fell, but which was preceded by some rain for one day, and succeeded by very heavy rain for four days. Four cases occurred on November 30th to December 2nd. Fourteen days prior to November 30th was

November 16th, when the sewer may have been blocked—as it certainly was on November 17th. Three cases occurred on December 5th, and thereafter for seven days from two to six cases occurred daily. Fourteen days prior to December 5th was November 21st, which was the second day of the somewhat heavy rainfall of November 20th and 21st, which, as suggested above, may have washed into the brook much infective material which had been stirred up in the sewer two days previously.

One case occurred on December 14th, which was fourteen days after a small fall of rain on November 30th. Two cases began on December 16th, which was twelve days after the heavy fall of rain on December 4th. One case occurred on December 19th, which was fifteen days after this date. One of the cases of December 23rd was undoubtedly a secondary one. The other of that date, and the case of December 25th, may perhaps, as I have already stated, be placed somewhat earlier. But in any event they occurred only nineteen and twenty-one days after December 4th, and are therefore within a not uncommon period of incubation of enteric fever if the infection had taken place on that day.

SANITARY ADMINISTRATION.

The Urban District Council of Kenilworth has twelve members. It meets once a month under ordinary circumstances. There are two committees for sanitary purposes—"Sanitary and Highways and General Purposes," and "Sewage Disposal."

The following Acts have been adopted by the Council:—

The Infectious Diseases (Prevention) Act, 1890; the Public Health Acts Amendment Act, 1890. Parts II., III. and IV.; the Public Health Acts Amendment Act, 1907, Part VI.; the Private Street Works Act, 1892; the Notification of Births Act, 1907; the Baths and Washhouses Acts; and the Public Health (Water) Act, 1878.

There are bye-laws in force for—

New streets and buildings; nuisances; cleansing of footways and pavements, the removal of house refuse, and the cleansing of earth closets, privies, ash-pits and cesspools; common lodging-houses; slaughter-houses; drainage of existing buildings, etc.

Regulations under the Dairies, Cowsheds and Milkshops Order, 1885, were made in 1905.

The medical officer of health is Dr. C. E. Tangye, who acts for the Warwickshire Combined Districts, of which Kenilworth is a constituent. Dr. Tangye receives a salary of £750 per annum, of which £29 is contributed by Kenilworth on the average.

The inspector of nuisances is Mr. Sholto Douglas, who is also Surveyor and Cemetery Registrar. Mr. Douglas devotes his whole time to these duties, and is paid a salary of £300 per annum, of which £120 is allocated for his duties as inspector of nuisances.

MEASURES TAKEN TO COPE WITH THE OUTBREAK OF ENTERIC FEVER.

The sanitary inspector learnt on the evening of November 21st, 1913, of the prevalence of gastro-enteritis in Kenilworth, and next

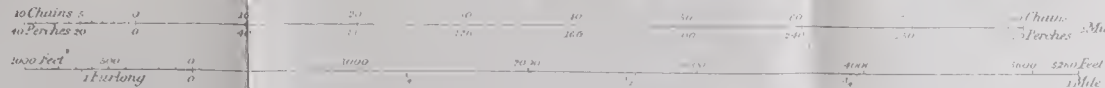


Copyright Reserved

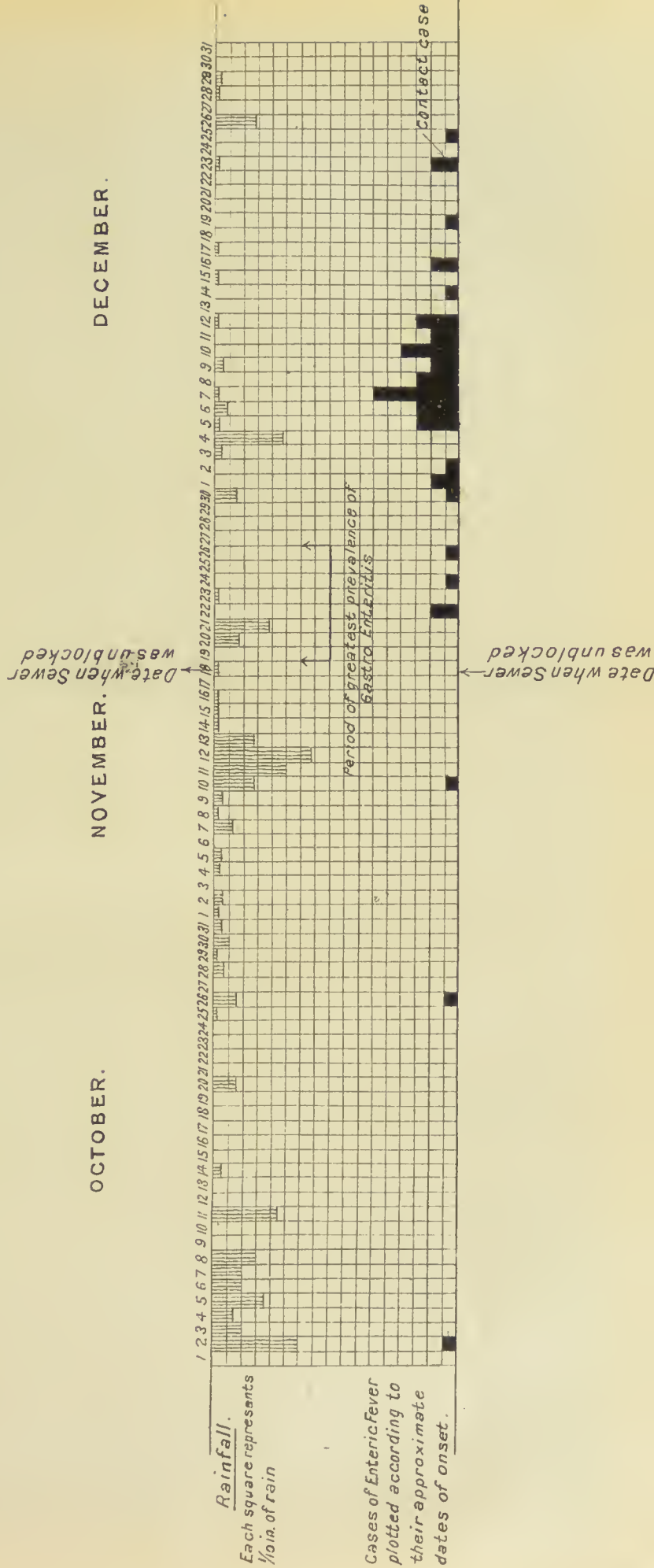
1061 133987 10 10 14

Scale — Six inches to One Statute Mile (i.e. 800 Feet to One Inch 1/2)

Printed by the Ordnance Survey Southampton, 1911



KENILWORTH ENTERIC FEVER OUTBREAK 1913.



Rainfall.
Each square represents
1/10th. of rain

Cases of Enteric Fever
plotted according to
their approximate
dates of onset.

day the matter was brought to the notice of the medical officer of health by the inspector and by a local medical man. It was suggested that contaminated water might be the cause of the gastro-enteritis, and steps were taken at once to forward samples of the local water supply to Professor Bostock Hill, and to the University of Birmingham, for chemical and bacteriological analysis respectively. These analyses showed that the water was impure, but that no bacilli of enteric fever nor of dysentery were discovered. The bacillus Coli was found in the water.

The reports and analyses of the sample reached the medical officer of health on December 2nd, and were submitted to the urban council, who were sitting in committee that evening. I understand that discussion took place at the meeting as to the position of the adit at the waterworks, and as to the possibility of its contents becoming contaminated from the adjoining stream.

The medical officer of health explained to the council the significance of the presence of B. Coli in a sample of drinking water. He advised that samples should be forthwith submitted to chemical and bacteriological examination from the adit and from each of the bore-holes separately.

The engineer of the water company, who is a member of the Kenilworth Urban District Council, was present at the meeting, and stated that the company would do everything possible in view of the unfavourable analyses of water just received. The council's surveyor was, however, directed to submit the analyses formally to the secretary of the water company and to make at the same time the suggestion that the differential analyses advised by Dr. Tangye should be made. Mr. Douglas did this next morning, December 3rd. The water company ultimately accepted the suggestion, but for some reason samples were not taken until December 8th, when a sample of water from the adit was forwarded by the water company to Messrs. Wyleys, chemists, of Coventry, for chemical analysis, together with a sample of water from an open spring near the waterworks. At the same time similar samples were sent to the University of Birmingham for bacteriological examination. The spring water had no immediate bearing on the case as it is not, I understand, used by the company for supplying drinking water, but it was thought, apparently, that if it were contaminated it would show that possibly the water of similar springs which find their way to the adit was being contaminated from a higher level.

I am informed by the water company's engineer that from December 3rd pumping was resumed from the newer bore-well which had not been in use for some months, and that from that date the adit water was only used to supplement the supply from the two bore-wells. On December 11th a councillor informed the clerk to the urban district council that adit water was still being pumped, and the clerk at once saw the secretary of the water company and urged that the company should desist entirely from using the adit water. They did not, however, do this until the afternoon of December 16th, it being feared that the water mains could not be kept full without adit water, and in that case back pressure might result and lead to the drawing in of contamination from outside the mains.

When two cases of enteric fever had been notified to him on the evening of Saturday, December 13th, and a third the following morning, Dr. Tangye feared the possibility of an outbreak of enteric fever, and considered the desirability of issuing notices advising people to boil all drinking water. He communicated with the county medical officer of health, with representatives of the Kenilworth Urban District Council, and of the water company, and on Monday, December 15th, the warning notice was issued. Some 1,100 copies of the notice were forthwith delivered in the town by hand, and about 20 were sent by post.

Before issue of the notices and by permission of the chairman of the water company, Dr. Tangye telephoned to the University of Birmingham on the morning of December 15th to learn the result of the bacteriological examination of the sample of adit water which had been submitted to the company on December 8th. He was informed that the water was quite unfit for drinking purposes; the results showed that serious, even gross, contamination of the water must have recently occurred. The water company received an unsatisfactory report of the chemical analysis of the adit water from Messrs. Wyleys on December 17th, and that afternoon they decided to abandon the use of the adit altogether, and to sink a third bore-hole. The company state also that they propose to erect now a filtering plant.

Samples of water from the two bore-wells were not forwarded by the water company for analysis until the morning of December 16th. The reports of these analyses showed that the water in the new bore-well was somewhat better than that in the old, and it was suggested that this latter might be receiving some surface or other contamination. This matter is referred to again farther on in the report.

It has been suggested that the district council should have issued warning notices as to the boiling of water forthwith upon the receipt of the analyses on December 2nd, and as, on this account, the council and the medical officer of health have been subjected to severe public criticism* it is necessary to consider the question rather fully.

As regards any effect which such action would have had, it may be said at once that as it happened, the issue of warning notices on December 2nd could have saved but few persons from contracting infection. Most of the cases were probably infected between November 22nd and 25th. On the ordinary reckoning of four-

* This criticism has specially been made by a committee of certain prominent residents in Kenilworth which came into existence early in January, 1914, in consequence of the outbreak. The committee, and particularly the chairman, Mr. Dudley Docker, C.B., have been so good as to bring to the notice of the Board, and of myself, certain matters in connection with the outbreak, directly or indirectly, which they considered should be specially investigated.

I understand that it is intended that the committee shall continue in being, for a time at any rate, with the object of directing public attention to any unsatisfactory sanitary conditions in the town. These matters have not come within the purview of the investigations I was instructed to make.

teen days' incubation, two cases were infected on December 2nd itself, leaving four, including one secondary case, in which infection presumably took place after that date.

It is clear in the light of subsequent events that the issue of public notices of warning immediately after December 2nd would have been advisable and creditable to the council had they decided to issue them. But it has to be considered that at the time:—

(a) The reports of the bacteriologist and analyst, which were before the council, were expressed in guarded terms. The question of enteric fever infection had not arisen, and the matter before the council was mainly the prevalence of gastro-enteritis, the relation of which to the water supply had been suggested but was by no means established. It might not unreasonably have been in the mind of the council that if they had issued notices and no epidemic had appeared, they would have laid themselves open to an action for damages by the water company. Also that the reputation of the town might have been impugned unnecessarily.

(b) The Council decided, on December 2nd, on the advice of their medical officer of health, to ask the water company for immediate further examination of samples from the different sources of supply, and as the engineer of the water company, who was present at the meeting, assured the council that the company would do everything possible in the matter, the council could hardly have anticipated the considerable delay which took place before these further samples were obtained and analysed.

(c) It was at the time conjectured that the suspected contamination might be taking place in the adit, and the council might reasonably have anticipated that they could rely on the water company cutting off the adit supply at once if they were satisfied that any risk of contamination of the adit water was arising.

I understand that the council were informed at the meeting on December 2nd that the adit could be cut off without interfering with pumping from the other sources.

I may add as a personal opinion that in all the circumstances known on December 2nd, if I had had to advise the district council I should have hesitated considerably before representing that the issue of public warning then and there was imperative.

Prior to my arrival in Kenilworth on December 19th, it had been suggested by Dr. Bostock Hill and Dr. Tangye that some disinfection of the water tank and water mains should be undertaken, and that the services of Dr. Houston, of the Metropolitan Water Board, who has had special experience of such work at home and abroad, should be secured. I strongly urged the secretary of the water company that Dr. Houston's services should be engaged forthwith, and a telegram was sent asking him to come down and undertake the work at once. Dr. Houston spent Saturday to Monday (December 20th to 22nd) in Kenilworth, and supervised the disinfection of all but the peripheral mains. These were disinfected by Mr. Douglas subsequently, upon lines formulated by Dr. Houston.

A copy of Dr. Houston's report to the water company upon his procedure is published as an appendix to this report.

The peripheral mains had to be cut off until they could be dis-

infected, and in consequence some inconvenience was experienced in the outlying parts of Kenilworth. To mitigate the inconvenience water carts were sent out for several days supplying water which had been drawn from the disinfected mains.

Ample *hospital accommodation* was available for all cases requiring hospital treatment. A few patients were treated in the Warneford General Hospital at Leamington, but most of those removed were admitted to the Heathcote hospital of the Warwick Joint Hospital Board.

In the early stages of the outbreak it was feared that additional hospital accommodation might be required, and arrangements were made to take over temporarily the Kenilworth Convalescent Home. The use of this institution did not, however, become necessary. It was suggested that the small-pox hospital possessed by the Joint Hospital Board might be used, but upon visiting it I found that there was no road adjacent, and that ambulances would have to traverse four fields to reach the hospital. I urged that a proper road should be made forthwith, but the authorities preferred instead to make the arrangement I have mentioned with the Kenilworth Convalescent Home.

Invaded premises were *disinfected* by an officer of the urban district council, who used formaldehyde gas for the purpose. *Clothing* was disinfected in the steam apparatus at the Heathcote hospital.

House to house visitation was made in the neighbourhood of invaded houses to see that suspicious cases of illness were receiving medical supervision.

The Warwickshire County Council allow Widal blood tests to be made at their expense in doubtful cases, and much advantage was taken of this arrangement throughout the Kenilworth epidemic. Not only were samples of blood taken by private practitioners, but many were taken by the medical officer of health at my suggestion for the purpose of ascertaining if persons apparently in good health at the moment had in fact suffered within recent times from enteric fever, and also to see if any of the cases of gastro-enteritis were really para-typhoid fever, or were due to organisms of the B. Coli group. In this way the case of Mrs. B——'s husband, who gave a positive result to Widal's test, was discovered.

The drains of houses where enteric fever had occurred were flushed freely with disinfectant, as were also the sewers in the neighbourhood.

An *assistant sanitary inspector* was engaged temporarily to assist Mr. Douglas, the inspector of nuisances.

Upon the occasion of my first visit to Kenilworth I conferred with the Chairman and Deputy-Chairman of the Kenilworth Urban District Council, and I expressed the opinion that everything possible had been and was being done to cope with the outbreak.

I saw the chairman again on December 23rd, and at a special meeting of the council the next day he communicated the substance of my remarks to his colleagues. The proceedings of this meeting were fully reported in the local Press on December 27th. On January 5th, by direction of the Board, I attended a public

meeting in Kenilworth, and made a short statement calculated to allay the anxiety which was alleged to exist in the district through fear that everything possible was not being done by the council and its officials.

CONCLUSIONS AND OBSERVATIONS ON THE PRESENT POSITION OF THE KENILWORTH WATER SUPPLY.

It has been shown that for many years the water company have been drawing water partly from their deep wells and largely from the adit. The adit was the only source of water supply for some years, and the use of it, presumably, was continued on the ground of cheapness, *i.e.*, saving of pumping, etc. The contamination of the adit water in the way or ways indicated in this report has undoubtedly been the cause of the recent epidemic.

The dangers to which the adit water was exposed were not solely a gross contamination, such as must have occurred as a result of the blocking of the Odiborne Close sewer. Any pollution of the brook water was liable in less degree to be dangerous to the adit water, and, apart from this, the position of the adit, and the sources of the water which normally reached it cannot be said at any time to have been such as to ensure a safe supply.

It is hardly desirable here to enter into the causes which have led to this risk having for so many years been ignored, but I think the principal reason is no doubt that the adit had so long been in existence that it was accepted by all concerned as an established source of supply, recognised by Parliament, and needing only occasional analytical checks rather as a matter of form than as an essential safeguard against an actual risk. As a fact some of the analyses made in the past have to some extent given indications that impurities might be gaining access to the water supply. It is to be regretted that the indications were not followed up. Responsibility in these matters must rest with the water company. The district council might have done more in the way of control analyses, but they had not the facts as to the sources and origin of the supply fully before them, and in any case had no responsibility for furnishing a supply of good quality.

The adit is not now drawn upon, the mains have been disinfected, and the supply is being obtained exclusively from the two bore-wells. A third bore-well is being sunk. A filtration plant is being considered.

It is evident that the measures for the future must receive careful attention both from the district council and the water company, and the question of the transfer of the works to the district council should receive special consideration. Under the terms of section 35 of the Kenilworth Water Order, 1882, the local authority were given the option of purchasing the undertaking upon giving 12 months' notice any time before the expiration of five years from the confirmation of the Order. It is much to be regretted that they did not exercise that option.

In considering the whole question of this water supply it will, of course, be necessary to decide whether any further precautions are needed to secure the purity of the water obtained from the bore-wells. In regard to this the analyses made in December last

of the water from the existing bore-wells showed that the quality of that afforded by the old bore-well was not quite so good as that of the new one. Both bore-wells are lined with steel tubes imperforate laterally to a depth of 72 ft. in the older and 100 ft. in the newer. If these tubes are sound, and are properly sealed above, no contamination should gain access to their interior, but the analyses suggest that some contamination does gain access to the older well.

Professor Bostock Hill advised the water company to have the tube of the old bore-well examined to see that water from the adit or elsewhere was not getting into this well, and I gave similar advice at a later date. The secretary of the water company subsequently informed me that an examination of the exterior of this bore-hole was being made by excavating the ground around. At the same time Dr. Houston advised the water company to consider if it would not be possible to arrange for the continuous chlorination of the water from the old bore-hole.

It is eminently desirable that the lining of the older bore-well should be carefully examined throughout the imperforate portion to see that it is thoroughly water-tight laterally. It is worthy of note that the lining of the older bore-well is a single steel tube, but that the tube in the case of the newer one is double. An engineering expert should be consulted as to whether a second tube should be fitted to the older well.

Lastly, the existing adit at the water works should be destroyed, so that it cannot remain an actual or potential source of contamination to the drinking water supplied to the residents of Kenilworth.

In conclusion, I beg to tender my best thanks to the urban district council and their officers, and to the directors and officers of the Kenilworth Water Company for assistance afforded me in the course of my investigations. Dr. Tangye, Mr. Douglas, and the officials of the water company worked unremittingly to cope with the outbreak, and while the disinfection of the water mains was in progress they were working both night and day. In these circumstances I was most reluctant to add to their work, although I was bound to do so. Nevertheless, every assistance and information I required was forthcoming most promptly and willingly.

APPENDICES A AND B.

Details of chemical and bacteriological analyses and reports of various samples of water.

[*Not here reproduced.*]

APPENDIX C.

COPY OF DR. HOUSTON'S REPORT TO THE KENILWORTH WATER COMPANY UPON
THE DISINFECTION OF THE WATER MAINS.

20, Nottingham Place, London, W.

January 2nd, 1914.

To The Directors of The Kenilworth Water Company.

I beg to report as follows on the work of disinfection of mains carried out under my supervision last month.

On December 20th, 23 ounces of Chloros (Sodium Hypochlorite) were added to about 14,000 gallons of water in the tank so as to give a dose approximately of 1 in 100,000.

The Chlorinated water was thereafter run through the mains until on testing with Potassium Iodide and Starch solution a distinct blue colour was obtained.

On December 21st the treatment was continued, but the dose was increased to 1 in 50,000, and about 20,000 gallons of water were treated.

The chlorinated water was then run through the mains which had not been previously treated, and tests as before were made with Potassium Iodide and Starch solution until the water gave a decided blue colour.

In this way all but the peripheral mains received an effective treatment with Chloros, and instructions were left to dose the remaining mains with a dose of 1 in 10,000 by means of an agreed upon procedure.

The sample of Chloros used in the experiments had been previously tested as regards its bactericidal power.

It was found that well water previously inoculated purposely with 0.1 per cent. of crude sewage was sterilised within five hours by a dose of 1 in 300,000. Even smaller doses (1 in 400,000 and 1 in 500,000) produced excellent although not quite perfect results.

In connection with the above tests it was found that the infected well water contained 73 excremental bacteria per cubic centimetre before the addition of Chloros (1 in 300,000).

Five hours afterwards no *B. coli* could be found in one hundred times this volume of water (namely, 100 cc.).

In my opinion the treatment adopted at Kenilworth would kill with certainty any typhoid bacilli lurking in the water tank or in the mains.

It would, of course, have no effect on the quality of water passed through the tank and mains subsequent to the treatment.

(Signed) A. C. HOUSTON.

APPENDIX A, No. 5.

DR. HUGH A. MACEWEN'S REPORT on an outbreak of
DIPHTHERIA in SOUTH LONDON attributable to MILK
INFECTION.

CIRCUMSTANCES OF THE OUTBREAK.

The Board learned, from a letter sent them by Dr. Wilkinson, the medical officer of health of Penge Urban District on the 31st December, 1913, of an outbreak of diphtheria in that district which he believed was attributable to milk from a certain dairy—in this report termed dairy “X”—situated within the Metropolitan Borough of Lambeth, which the Penge district adjoins. Dr. Wilkinson stated that he had communicated with Dr. Priestley, the medical officer of health of Lambeth, in which district a considerable number of diphtheria cases had occurred: and likewise with Dr. Clarke, the medical officer of health of the adjacent County Borough of Croydon, who had informed him that there were also cases of the disease in that district which were attributable to the same milk supply. Dr. Wilkinson also stated that he had informed the county medical officer of health of Kent, who concurred with him in his view as to the causation of the outbreak.

On 2nd January I received instructions to make inquiry into the circumstances of the epidemic and commenced my investigation on the same day. I immediately got into communication with the medical officers of health of the districts concerned and learned from them that the disease was not confined to Lambeth. Croydon and Penge, but that cases had also occurred in two other boroughs in South London—Camberwell and Lewisham—and in the urban district of Beckenham, and that the circumstances connected with the cases in all these districts pointed to milk from dairy “X” as the vehicle of infection.

EVIDENCE POINTING TO MILK AS THE SOURCE OF INFECTION.

When cases of diphtheria occur in six different districts and when, on investigation, it is discovered that milk supplied from one out of a large number of dairies is the factor common to all the households affected, the presumption is strongly in favour of the milk being the vehicle of infection. In the present instance it should be understood that diphtheria was prevalent in the administrative districts concerned apart from the households

receiving the implicated milk supply. The districts altogether constitute a large part of southern London and its outskirts, having a total population of nearly 1,000,000, and shared in the general prevalence of diphtheria which, during the autumn and winter of 1913, had been met with throughout London. Nevertheless, a great disproportion of incidence on customers obtaining milk from dairy "X" (stated at 3,020 households) when compared with the total of households (216,830 separate occupiers according to the 1911 census) in these six administrative districts was evident, as is brought out by the tabular statement below.

A more desirable comparison would be between the incidence on (a) households receiving milk from dairy "X," and (b) other households, within the much smaller area comprised in these districts in which milk from dairy "X" was habitually distributed. Unfortunately this area does not admit of precise definition and there are no available figures by which to estimate its population. There could, however, be no question of the exceptional incidence on the households receiving milk from dairy "X" within this area.

Population 1911 Census.				Separate Occupiers ("tenements") 1911 Census.
1.	Lambeth	...	298,058	70,827
2.	Camberwell	...	261,328	58,679
3.	Lewisham	...	160,834	37,013
4.	Croydon	...	169,551	38,503
5.	Penge	...	22,330	4,840
6.	Beckenham	...	31,692	6,968
Total of these districts ...				216,830

Week by week totals of diphtheria notifications in above districts:—

	Total cases notified.	Cases in households supplied by Dairy "X" (3,020).	Cases in other households (213,810).
Week ending 15th November	36	0	36
„ 22nd „ ...	52	0	52
„ 29th „ ...	55	9	46
„ 6th December ...	87	34	53
„ 13th „ ...	92	38	54
„ 20th „ ...	86	29	57
„ 27th „ ...	46	6	40
„ 3rd January ...	50	3	47

In further illustration I may add that I was informed by Dr. Wellesley Harris that in a particular portion of Lewisham no diphtheria had occurred for a month before the end of November, when five households were infected within a fortnight, all of them being customers of dairy "X," which is only one of many dairies supplying milk in this part of the borough. Again,

in the particular district of Camberwell where the cases supplied with milk from dairy "X" occurred, there were only four other cases of diphtheria obtaining milk from sources other than dairy "X," so that here also this particular milk seems to have been responsible for introducing the disease into the district.

Pasteurization of all milk sent out from dairy "X" was commenced on 12th December, and six days after that date the epidemic practically came to an end.

NUMBER AND DISTRIBUTION OF CASES.

There were in all 119 cases. Two cases in Penge which fell ill on 9th October and 8th November respectively, and one case in Lambeth which sickened on 17th November, have not been included, as it seems probable that in these cases milk from the dairy in question was not the source of infection.

The distribution of the cases was as follows:—

Croydon	...	...	...	...	...	...	42
Lambeth	...	...	...	...	...	...	33
Penge	...	...	...	...	...	...	19
Camberwell	...	...	...	...	...	...	14
Lewisham	...	...	...	...	...	...	7
Beckenham	...	...	...	...	...	...	4
Total ...							119

These include some which occurred in the same house, and may, in part at least, have been due to secondary infection.

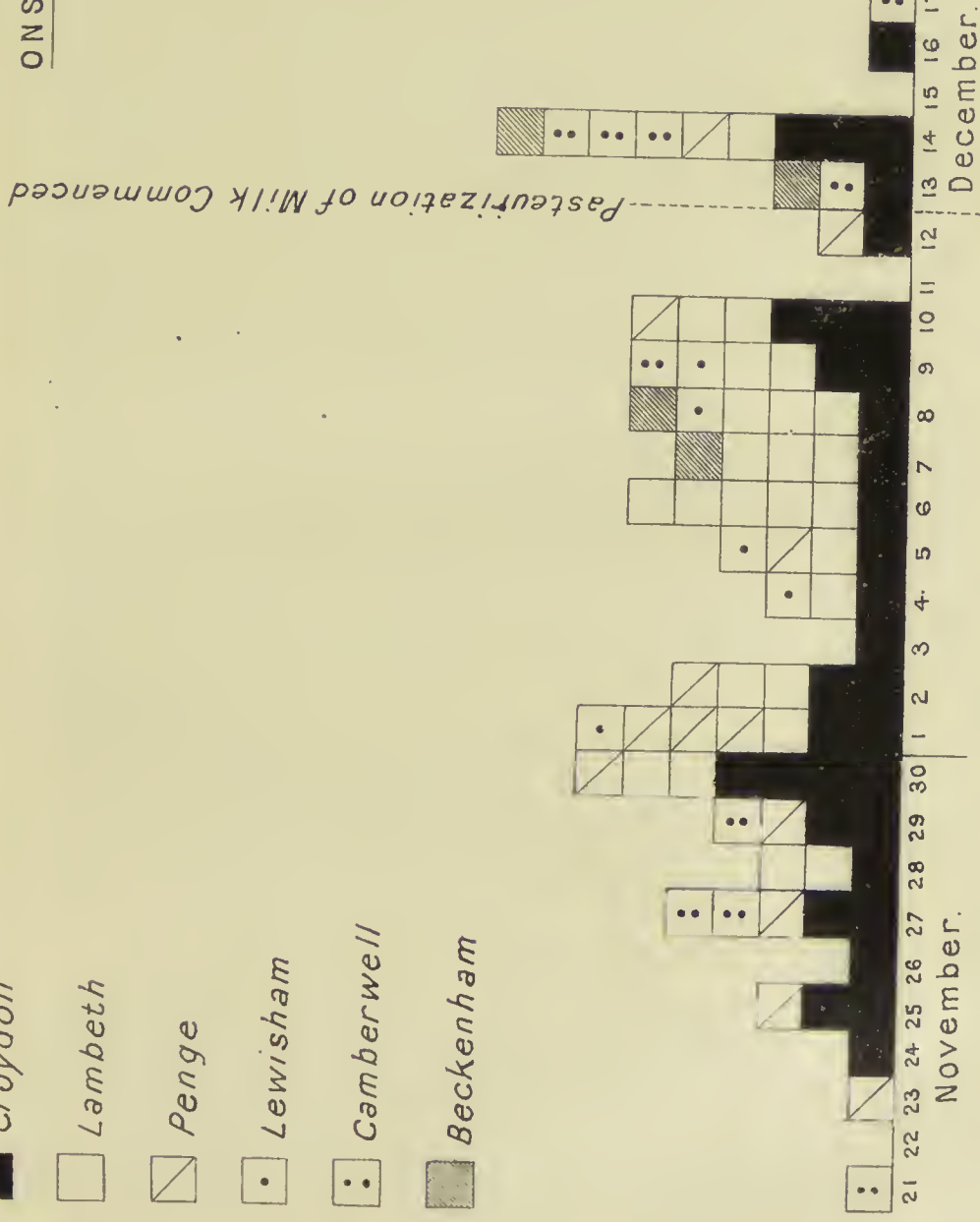
A total of 94 houses were affected. The diagram shows for each district the date on which the first case was attacked in each house.

It will be observed that the epidemic commenced on the 21st November, and that from the 25th November to the 14th December—a period of 20 days—it continued to attack, on an average, 4.3 new houses per day, the highest number of new houses attacked on any one day being nine. After the 14th December the number of cases rapidly became less, and the epidemic practically came to an end on the 18th December. There was only one death among the 119 cases.

I was informed by several of the medical officers of health concerned that the houses attacked were nearly all inhabited by persons belonging to what may be termed, for the sake of distinction, the "better class," where presumably large quantities of milk were ordinarily consumed, and that very few cases had occurred amongst the poorer inhabitants who were also in the habit of obtaining their milk—though probably in lesser quantities—from dairy "X." This fact I was subsequently able to corroborate, as I found on making inquiry at the dairy that large quantities of milk were supplied to most of the affected households.

ATTACKED IN EACH HOUSE.

ONSET OF ILLNESS OF FIRST CASE



AGE AND SEX INCIDENCE.

	Ages in Years.										Total.
	0-	5-	10-	15-	20-	25-	30-	35-	40-	45 & over.	
No. of cases, Male ...	1	3	15	8	5	4	1	1	—	3	41
„ Female ...	1	11	10	12	9	10	5	3	6	11	78

It is, at first sight, surprising to find that so few cases under five years of age suffered attack from diphtheria if an infected milk supply was the cause of the epidemic. It was found, however, that special milk was supplied from the dairy in question in sealed bottles for nursery purposes. This milk was derived from some 21 cows kept at the dairy at Lambeth, and did not come in contact, in any way, with the milk obtained from other sources, which, in order to secure uniformity of quality, was all mixed together before being sent out. Such milk was supplied habitually to the better-class customers only, who could afford to pay the enhanced price charged for milk of this quality, and its use by persons so circumstanced does not explain the absence of infection among the infants and young children of the poorer classes, though people in this position in life formed a very considerable proportion of the dairy's customers. As regards young children it is not customary for the working classes to give them milk to drink in any great quantity (its use being generally confined to the addition of a small quantity to tea or other beverage, or with puddings or farinaceous foods), and the dose of infected milk would probably have been small. As regards those infants, not breast fed, for whom the ordinary milk supplied by the dairy in question may have formed the sole source of nutriment, it may be pointed out that milk so given is usually manipulated to render it suitable to the special requirements of infancy, and the heating to which it is generally subjected for this purpose may have, in many cases, been sufficient to destroy any diphtheria bacilli present. That bacillus, when in a moist condition, is killed by a few minutes' exposure to temperatures as low as 58° C., or about 136·4° F.

That the number of females should be nearly double the number of males is significant as, so far as adults are concerned, women generally drink more milk than men, and it is interesting to note that a considerable number of domestic maid-servants, engaged in good-class houses, were infected.

CIRCUMSTANCES IN CONNECTION WITH DAIRY "X."

Dairy "X" is situated in Lambeth and the district which it supplies with milk is a very large one, not being confined to Lambeth but extending also into Penge, Croydon, Lewisham, Beckenham and Camberwell.

The following statement shows the number of cases of diphtheria attributable to this milk supply and, approximately, the

number of houses supplied with the milk in the several districts concerned:—

	Houses supplied.*	Cases of diphtheria.
Croydon	1,000	42
Lambeth	1,000	33
Camberwell	500	14
Penge	400	19
Lewisham	100	7
Beckenham	20	4

As soon as Dr. Priestley became aware of the fact that cases of diphtheria were being caused by consumption of milk from dairy "X" he suggested that all the milk should be pasteurized before leaving the premises. This suggestion was immediately acted upon by the dairyman, who was anxious to do all in his power to assist the officials of the Sanitary Authority to bring the epidemic to an end, and pasteurization of the milk was commenced accordingly on 12th December.

The milk was raised to a minimum temperature of 180° Fahr. by passing it in a thin stream over the coils of the pasteurizer, after which it was placed in the milk churns and subsequently chilled before delivery.

Dr. Priestley also caused swabs to be taken from the throats of all members of the dairy staff. Twenty-two men are regularly employed in distributing milk to the customers. On bacteriological examination diphtheria-like organisms were found in the throats of four of the regular milk distributors, and also in the throat of an odd man "F," who had been employed in distributing milk during the course of the epidemic. The services of these affected milk distributors were, very properly, immediately dispensed with—one on 3rd December, three on 18th December, and one on 23rd December. As it appeared that the five men in question had supplied a considerable number of the customers with milk, it was, at first sight, suspected that the source of contamination of the milk had been discovered. When, however, this aspect of the question was more carefully gone into, it was found that a large number of diphtheria cases had occurred upon the regular rounds of milk distributors who were not diphtheria carriers. It at one time seemed possible, on consideration of data supplied to me by Dr. Priestley, that certain distributors who went to miscellaneous houses independently of the regular round, on what was known as the "pudding round," might have been agents of infection. But diphtheria occurred in many houses which, so far as could be ascertained, had not been supplied on the special "pudding round," while other affected households which took

* Figures supplied by Dr. Priestley. It may here be added that in Camberwell one large institution (a public school) received milk from dairy "X," and no diphtheria occurred among the scholars. I ascertained, however, that the daily supply of milk to this school was relatively small and that the milk was almost entirely used for cooking purposes and in tea.

"pudding milk," did not receive it from distributors in whose throats diphtheria-like organisms were found. As a whole the facts were inconsistent with the explanation that the epidemic could, in its essential features at all events, be attributed to infection conveyed by a number of different distributors with diphtheria bacilli in their throats.*

At the time of my first visit to Dr. Priestley, on 5th January, the investigation of the supposition that the distributors with diphtheria bacilli in their throats had been the cause of the epidemic had mainly occupied his attention, although, as a matter of precaution, letters had been sent by him to the medical officers of health for the districts in which the farms supplying milk to dairy "X" are situate, requesting them to inspect the farms in question and report anything likely to throw light on the prevalence of diphtheria among the consumers of the milk.

A reply to one of these letters which came to Dr. Priestley on 5th January showed that diphtheria was suspected at a farm at Horsham which sent milk to dairy "X," and this information having been communicated to me I at once visited Horsham, subsequently communicating the results of my inquiries to Dr. Priestley and to the other medical officers of health concerned for their guidance in administration.

Before entering upon this matter it should be said that the conditions of the business carried out in dairy "X" make it impossible to refer the milk delivered on any of the milk rounds back to the farm or farms from which the milk distributed on the round had been obtained.

In addition to the limited quantity of milk, already referred to, derived from cows kept on the premises at Lambeth, dairy "X" received the major portion of its supply from some 17 farms situated in the counties of Surrey and Sussex, and from certain creameries and milk factories. Milk was sent from most of these farms twice daily, arriving at the nearest railway station in the forenoon and at night. The milk churns were removed from the trains and left standing on the station platform until called for by the dairyman's employes for transference to the dairy premises. As already stated it was customary to mix together, twice daily, all the milk arriving at the dairy. This process was effected in three drums, one with a capacity of 100 gallons, and two of 50 gallons each. The milk was emptied from the churns into the drums until the latter became full, when it began to be drawn off, and, after that, the two processes of filling and drawing off were continued at one and the same time until all the milk supply of the dairy, which comprised a daily supply of between 700 and 800 gallons, had been dealt with. Owing to the circumstance that the churns were emptied into the drums in a haphazard fashion without any

* Whilst this report was in the press, Dr. Priestley's report on the subject to the Lambeth Borough Council has been issued, in which the information which he obtained as to the different distributors is fully set out. It appears that 2 of the 22 distributors had bacilli in their throats which Dr. Priestley definitely classes as Klebs Loefller; one had the Hoffman bacillus, while diphtheroid bacilli were discovered in the throats of one distributor and the odd man F.

attention to the order in which they were taken or as to the source from which the milk they contained was derived, the resulting mixture probably contained milk from a large proportion of the different sources in question.

As already stated, Dr. Priestley had, in December, made inquiry by letter of the medical officers of health of the districts in which the farms are situated, and early in January like information was obtained in answer to letters sent by the Medical Officer of the Board. These replies were to the effect that the circumstances of the farms in question were generally satisfactory. No history of sore throat or other recent illness among the milkers or dairy workers was forthcoming, and it was further stated that the cows, which had, in many cases, recently been inspected by a veterinary surgeon, appeared in good health, while no serious exception could be taken to the prevailing sanitary conditions of the farm premises. Dr. Child (medical officer of health of the West Sussex Northern Combined Sanitary District), however, reported that at one of the farms in Horsham Rural District a milker had been discovered suffering from what was known as a "milker's finger." The condition of this finger had become so serious that it was deemed advisable to have it amputated, and the operation was accordingly performed at the local cottage hospital about Christmas time. Dr. Child, having in mind that an epidemic of diphtheria was alleged to have been produced by milk derived from a considerable number of sources, of which the farm at Horsham was one, sent the amputated finger to the Clinical Research Association for bacteriological examination, with the result that a virulent diphtheria bacillus was isolated, which, on inoculation into a guinea pig, killed the experimental animal in 48 hours.

CIRCUMSTANCES CONNECTED WITH THE FARM AT HORSHAM.

I visited the farm in question at Horsham on 6th January, and on several subsequent occasions, being generally accompanied by Dr. Child, who did everything in his power to facilitate my enquiry, and on one occasion by my colleague, Dr. Littelljohn, in order that I might have the benefit of his veterinary knowledge and experience. We received much help from the farmer, who showed himself at all times willing and anxious to assist us in every way in elucidating the problem under investigation.

We found that there were 44 milch cows at the farm, and that the whole milk supply, comprising from 75 to 90 gallons daily, was sent to dairy "X" in Lambeth, no milk from the farm being distributed locally. It was customary to despatch three churns in the morning and two at night to dairy "X."

The Milkers.

We, in the first place, made enquiry as to the circumstances connected with the milker whose finger had been amputated and on bacteriological examination had revealed the presence of the diphtheria bacillus. For convenience of subsequent description this milker may be designated as "A." It was stated that the approximate date on which the finger was first affected was 15th September. The condition does not appear to have been

regarded as at all serious until about the beginning of December, when it began to ulcerate. The man ceased milking on 23rd December. On being questioned he affirmed that he had noticed sores on the teats of the cows milked by him before his finger became affected, but that he regarded them as of little consequence, seeing that he had often seen sores on the teats, which are popularly supposed to be produced by "flies" during the autumn months:

This man does not reside at the farm but at Broad Bridge Heath in the Horsham Rural District.

A few cases* of diphtheria had been notified during 1913 in this district, but none at any time during the year from the neighbourhood in which he lives.

I took swabs, on 21st January, from this milker's throat and from that of his wife and child, and sent them to the Lister Institute for bacteriological examination, with negative results.

We next examined the other milkers at the farm: they were four in number, and all men. Particulars regarding them are given below:—

"B," residing in Horsham Urban District, commenced milking on 26th November, and continued until 14th January. It was noted that this man had sores on the thumb and first finger of one of his hands. These sores were crusted over the surface, but on exercising gentle pressure a clear fluid exuded. This fluid was collected on 21st January upon the sterilised cotton wool of a swab, such as is generally used in investigating the condition of the throat, and sent to the Lister Institute for bacteriological examination. From this swab a virulent diphtheria bacillus was obtained, which, on inoculation into a guinea pig, killed the experimental animal in 48 hours. On being questioned as to when the sores had first made their appearance, "B" replied that he was unable to give the exact date, but he had nothing wrong with his hands before he commenced milking.

"C," residing in Horsham Urban District, commenced to milk on 18th December and had continued to do so up to the date of our visit (21st January). He had no sores on his fingers or hands.

"D," also residing in Horsham Urban District, had been milking at the farm for over a year. He had a large sore on the back of his hand besides other smaller sores on his fingers. The large one was about the size of a shilling, had clear cut edges, was crusted over the surface and appeared to be at a later stage of development than those on the fingers of "B." He stated that this sore had first commenced about ten weeks before, *i.e.*, about 13th November. It was quite dry, and we were unable to obtain moisture from it. The "swab" taken in these circumstances, on examination, gave negative results.

"E" resides at a cottage on the farm. He had been off

* The total number of cases was 11, notified, respectively, on January 4th (four cases), January 18th and 25th, February 1st, April 12th, June 21st, September 27th, and November 15th (one case on each occasion).

work for a while with an attack of influenza, and had only recommenced to milk a few days prior to the date of our visit. His hands were quite free from sores of any sort.

We swabbed the throats of all these milkers and also of the farmer, his wife and daughter; the results of their examination for the diphtheria bacillus at the Lister Institute were negative.

It will be noted that three of the above milkers reside in Horsham Urban District. Inquiry was, therefore, made as to the number of cases of diphtheria which had occurred in that district during the year and as to any possibility of the said milkers having become infected by direct contact with cases, or otherwise. The number of cases notified during the year in Horsham Urban District is as follows:—

Week ended.				Cases notified.	Week ended.				Cases notified.
1913.					1913.				
January	4	...	...	—	July	5	...	...	—
	11	...	...	—		12	...	...	—
	18	...	...	—		19	...	...	—
February	25	...	...	—	August	26	...	...	—
	1	...	...	—		2	...	...	—
	8	...	...	—		9	...	...	—
March	15	...	...	—	September	16	...	...	—
	22	...	...	1		23	...	...	—
	1	...	...	—		30	...	...	—
April	8	...	...	—	October	6	...	...	—
	15	...	...	—		13	...	...	1
	22	...	...	—		20	...	...	1
May	29	...	...	—	November	27	...	...	—
	5	...	...	—		4	...	...	2
	12	...	...	—		11	...	...	1
June	19	...	...	—	December	18	...	...	1
	26	...	...	—		25	...	...	—
	3	...	...	—		1	...	...	—
July	10	...	...	—	January 3, 1914	8	...	...	1
	17	...	...	—		15	...	...	2
	24	...	...	—		22	...	...	—
August	31	...	...	—	February	29	...	...	1
	7	...	...	1		6	...	...	—
	14	...	...	—		13	...	...	1
September	21	...	...	—	March	20	...	...	1
	28	...	...	—		27	...	...	—

Dr. Child informed me that the homes of the milkers are not situated in the parts of the urban district in which cases of diphtheria occurred during the autumn months, and that he could not account for their infection from any source in Horsham. He did, however, accidentally discover, while engaged in the medical inspection of school children, that the brothers and sisters of the milker "D" attend a certain school in Horsham, and that one of the scholars at this school was notified as suffering from diphtheria on 17th September. As there was only a single case, and as there was apparently no spread of the disease among the school children, it seems unlikely that there was any connection between the sores on "D's" hand and the fact that his brothers and sisters may possibly have been exposed to diphtheria infection at school.

Condition of the Cows.

On careful inspection of the cows we found that five of them had irregularly shaped sores on the udder and teats. These sores, which varied in size from that of a threepenny bit to a shilling or larger, were covered with brownish black scabs raised above the surface. They were situated on the upper half of the teats, sometimes at the junction between the teat and the udder, and resembled the sores on the milkers' hands. Unfortunately, at the date of examination, the healing process was practically complete and, on removal of the scabs, a dry surface was found beneath so that it was impossible to take swabs with a view to the discovery of the causative micro-organism. The affected cows were housed in two cowsheds in each of which four animals were accommodated. These cowsheds were distinct from those in which the remaining 36 cows were housed, and thus in the sheds in question five cows out of eight had suffered from the condition. It should be added, however, that among the cows in the other cowsheds a few had slight sores or cracks on the teats, while one was found suffering from mastitis.

Other Considerations at the Farm.

It was the custom for all milk to be cooled at the farm before being despatched for transit to London, it being the practice for each milker to bring his pail, as soon as full, from the byre to the dairy, and to empty its contents into the receiver of a refrigerator from which it passed over the refrigerator and thence into the milk churns. This cooling of the milk at the farm is a matter of importance in the present inquiry as the growth of any diphtheria bacilli which the milk might contain would probably be checked by the process of cooling to which it was subjected, and in the comparatively cold weather obtaining at the close of last year further multiplication of the organism in the milk seems unlikely. The water used for dairy purposes is derived from a pond situated in an open field at a higher level than the farm buildings. The ground surrounding this pond is ploughed up by the feet of cattle which evidently make use of it for drinking purposes, and animal pollution of the water from this source is inevitable. The water is piped from the pond into a tank sunk in the ground adjoining the dairy and said to be constructed of brickwork lined with cement. The water, as seen in a glass, is opaque, and contains a great deal of suspended matter. No doubt the bulk of such water is boiled before being used for the cleansing of the milk churns and other utensils, yet as such vessels are not uncommonly rinsed out with cold water, it is unfortunate that the quality of water used for such purposes should not be above suspicion. The general sanitary condition of the farmstead left much to be desired.

SUMMARY AND CONCLUSIONS.

A consideration of the circumstances of the epidemic given in the preceding pages of this report clearly points to the farm at Horsham as the source of infection. Some general comment upon

the conditions found at the farm in their relation to the more prominent features of the epidemic seems desirable.

In the first place, attention should again be drawn to the fact that the milk was chilled almost immediately after it was drawn from the cows (in no case, so far as I could ascertain, was it likely to stay more than half an hour before cooling), and that the weather was comparatively cold during the period when the epidemic occurred. Presumably, therefore, though it is stated that the diphtheria bacillus will multiply in milk at comparatively low temperatures, the conditions were such as to retard the multiplication of the diphtheria bacilli which the milk contained.

In addition it has to be remembered that at dairy "X" this milk was habitually mixed with a much larger volume of other milk before it reached the consumer. Both the above considerations indicate that the initial dose of infection at the farm was relatively large.

The next question of importance is, from whence did the milk derive specific infection? Three of the milkers had sores on their hands. In the case of two of these ("A" and "B") virulent diphtheria bacilli were obtained from the lesions on bacteriological examination. The third man ("D") had sores which appeared similar in nature but they gave a negative result on bacteriological examination, though, as they were practically healed at the time when we saw them, the fact of the non-discovery of the diphtheria bacillus does not exclude the possibility of its presence at an earlier stage. It may be convenient to focus attention on certain circumstances in connection with these milkers, which have an important bearing relatively to the epidemic, by means of a tabular statement:—

Period of Milking.	First appearances of sores on the hands.	Results of bacteriological examination of sores.
"A."—Regular milker, ceased milking December 23rd.	September 15th ...	+ (Finger examined on Dec. 29th, 1913.)
"B."—Commenced November 26th, ceased January 14th.	After November 26th	+ (Swabbed Jan. 21st, 1914.)
"D."—Regular milker, ceased about January 21st.	About November 13th	Diphtheria bacilli not found. (Swabbed Jan. 21st, 1914.)

"A's" finger first commenced to trouble him on 15th September but it was not regarded as at all serious until the beginning of December, when it began to ulcerate. It seems unlikely that this finger would be capable of adding infective property to the milk, at least to any notable extent, until about the beginning of December, when ulceration set in. As "B" only commenced to milk on 26th November and, as he states that he had no sores on his hands prior to the time that he began to milk the cows, it is probable that he did not become an infective agent until a date subsequent to 1st December. "D," on the other hand—if his sores contained the specific organism—was possibly a source of danger about the

same period, or rather earlier than "A," toward the end of November or beginning of December.

In regard to the time relation between the occurrence of these sores on the milkers' hands and the infectivity of the milk, the epidemic, as has been said, commenced on 21st November and gradually ascended until 30th November and 1st December, when, with occasional intermissions it continued pretty evenly until 14th December. From this date the epidemic fell away and the milk supplied by dairy "X" practically ceased to be infective after 18th December. This cessation of infectivity is attributable to the pasteurization of all milk at dairy "X" after 12th December, and not to any alteration of the conditions at the Horsham farm. In fact, all the circumstances suggest that for several weeks after 12th December the milk sent from Horsham to dairy "X" was still diphtheria-infected. The efficiency of pasteurization, when properly carried out, in rendering harmless a milk contaminated with an easily killed organism such as the diphtheria bacillus, appears to have been well illustrated by this outbreak.

As regards the cows, it would have been very desirable to present a similar table to that given in connection with the milkers, as to the date of appearance of the sores, and their extent, on each cow. Unfortunately, very little attention had been given to them and the facts could not be ascertained. It was observed that typical sores only appeared on the teats of cows in two of the cowsheds and that the cows in the other cowsheds had apparently escaped infection. The only other fact that appeared tolerably certain was, as already stated, that sores had been observed on the cows' teats before the first milker's finger was affected.

It is difficult, if not impossible, to dissociate the cows from the milkers in considering how the milk became infected. The milkers could hardly have been infected one after another on the fingers apart from the agency of infection on the cows' teats which they handled, and the simultaneous presence of sores on the teats shows how this infection may have come about. Evidence recorded in connection with one or two previous outbreaks has pointed to the cow as a possible agent of transmission of diphtheria bacilli to milk; notably, in more recent years, that adduced by Dr. Ashby in 1906, where the bacilli were obtained from sores on the teats of cows supplying milk which had caused an outbreak of diphtheria.*

If, however, the sores on the cows' teats at the Horsham farm are, for the sake of argument, neglected, it might be suggested that the milkers "B" or "D" owed their sore fingers to the diphtheria infection accidentally left on the udders and teats by "A," the teat acting merely as any other carrying surface might have done if kept warm and wetted with milk. But against this supposition is the fact that the milkers did not ordinarily follow one another in milking the cows. Each milker had a certain number of cows allotted to him, and no such practice, for example,

* *Public Health*, 1906, xix, p. 145. In this case the milkers' hands appear not to have been infected.

as one man milking all the cows in the morning and the other milking in the afternoon was ascertained to exist. It seems more probable that the cows in question, by means of diphtheria bacilli contained in the sores, whether or not these had received infection from a human source, were the means of transmitting infection to the milkers and possibly also that diphtheria bacilli contributed by the cows added to the infectivity which the milk obtained from the diphtheria bacilli in the sores on the milkers' fingers. In this connection it may be remembered that the large number of cases produced during the epidemic, as a result of milk consumption, and the fairly regular day by day incidence of attack, seem to indicate an abiding source of infection of considerable intensity. In view of the possibility that diphtheria bacilli may have been present in the milk sinuses of some of the cows, I took samples of milk on 2nd February and submitted them to the Lister Institute for examination for the presence of the diphtheria bacillus, but with negative results. Not much importance can be attributed to a negative result in connection with a single observation of this nature, late in the day, when the external lesions so far as the cow was concerned were healed.

To some further questions which naturally arise, the facts available do not permit any satisfactory answer to be given. Dr. Littelljohn pointed out that the sores on the teats resembled cowpox; on which assumption diphtheria infection of the teats may have been something super-added to sores caused by another disease of the cow,* rather than that the sores on the teats were essentially a local manifestation of diphtheria.

As soon as the presence of the diphtheria bacillus was discovered in the sores on the hands of milker "B," he and his colleague "D" were given other work to do at the farm, their place being taken by new milkers. The milk, from the cows with sores on their teats, was excluded from that sent from the farm until samples had been taken from the infective cows and submitted to bacteriological examination with negative results.

In conclusion, I have much pleasure in thanking Dr. Child for his cordial co-operation in the prosecution of the present inquiry. I also desire to put on record my appreciation of the courtesy and assistance which I received from Dr. Priestley, Dr. Wilkinson, Dr. Wellesley Harris and the other medical officers of health concerned, and my thanks for the information regarding the epidemic or the circumstances of the farms in their respective districts with which they were good enough to furnish me.

* To assume that the milkers had cowpox, of the fingers, and then each contracted diphtheria infection on the top of it is to leave the source of their diphtheria infection unsolved. The fact may be mentioned, for what it is worth, that the milker "B," a man of 32, had been vaccinated in infancy and had five large foveated scars on his arm, while "D," a lad of 16, and also vaccinated in infancy, had four very well-marked scars. It is open to question whether, in view of their vaccinated condition, these milkers would have acquired cowpox, especially in the case of the boy.

APPENDIX A, No. 6.

DR. HUGH A. MACEWEN'S REPORT on an Outbreak of SMALL-POX in MILNROW, in its relation to infection in a COTTON MILL.

I visited Milnrow Urban District on the 3rd June, 1914, and on subsequent days for the purpose of making inquiry into the circumstances connected with an outbreak of small-pox in that town. Up to the time of my leaving the district on the 19th June there had been eleven cases among which there were fortunately no deaths. All of the cases were persons employed at the New Ladyhouse Cotton Mill. It should be added that two persons not employed at the New Ladyhouse Mill were notified as suffering from small-pox, but they subsequently proved to be cases of measles, a disease which was prevalent in the district at the time. Particulars regarding a single case at Rochdale which is connected with the Milnrow series are reserved for consideration at the end of this report.

The dates of first appearance of the eruption in the eleven Milnrow cases were as follows:—

May 30th	...	...	...	4 cases.
„ 31st	...	...	...	5 „
June 1st	...	...	...	1 case
„ 2nd	...	...	...	1 „

It seemed therefore that there was some source of infection common to all the cases, and operating at the mill. So far as could be ascertained, none of the patients had been recently out of the district and no source of infection, outside the mill, could be suggested.

The New Ladyhouse Mill is divided into two parts. In the first part the bales of cotton are opened out and a series of manufacturing processes are gone through ending with that known as “roving,” whilst in the second the cotton is finished in a variety of ways. All the workers who contracted the disease worked in the first of the two parts.

The cotton passes through the following processes in the part of the mill where the disease occurred:—

1. *Mixing Room*.—All the cotton used in the mill is first elevated to the mixing room, which is on the first floor directly above the blowing room. Two men are employed in the mixing room in opening the bales and blending different sorts of cotton (“American,” Brazilian, Peruvian, Mexican, &c.), and passing it through the bale-breaking machines. One of these two men contracted small-pox.

2. *Blowing Room*.—From the bale-breaking machines the cotton passes into the blowing room beneath, in which two men work. More dust is probably produced in the blowing room than in any other part of the mill, and the “blowers” are brought more intimately in contact with it, as they have to clean out the dust by hand from the machines three times a day. This is significant as both “blowers” took small-pox.

All the cotton used in the mill passes through the hands of the above four men of whom three contracted the disease.

3. *Carding*.—The cotton from the blowing room is carried into the main building by four cardroom jobbers, who also attend to the

carding engines. In the process of carding the cotton fibres are combed and opened out. One cardroom jobber took small-pox.

4. *Can-breakers*.—Two can-breakers are employed in conveying cans of cotton from the carding engines to the drawing frames; one became affected with small-pox.

5. *Drawing frames*.—Four women and four assistants are engaged in attending to the drawing frames; one of them contracted small-pox.

6. *Slubbing frames*.—The cotton next passes through the slubbing frames at which four slubbers and four assistants work; three of the slubbers contracted the disease.

7. *Intermediate roving frames*.—Six women work at the intermediate roving frames, none of whom contracted small-pox.

8. *Roving frames*.—There are 16 pairs of roving frames at which eight women work; one contracted small-pox.

9. *Ring-room operatives*.—One out of a large number of ring-room operatives became infected with small-pox.

There was no such difference between the operatives in the different parts of the mill, in regard to their protection against attack by small-pox, as would explain the distribution of the disease above described.

Among the persons attacked by small-pox, one had not been vaccinated; the remaining 10 had been vaccinated in infancy, but not re-vaccinated.

It might be expected, on the hypothesis of infection contracted from the raw cotton, that those who first came in contact with the cotton should have been the first to sicken. This was not strictly the case. It should, however, be understood that the cotton passes quickly through the various processes of manufacture and that it would probably be handled by a large number of those who contracted the disease within a few hours of one another and by all within one or two days of its entering the mill. Thus, allowing for occasional variation in the length of incubation period, little significance attaches to the fact that sequence in the order of date of onset of illness did not in fact exactly correspond with sequence in the handling of cotton.

From the manager of the mill I ascertained that the cotton used was derived from a considerable number of sources. Thus "American" cotton was employed and also cotton from Peru, Mexico, Brazil, Texas and California. He explained that spinners in this country do not often use Mexican cotton; but that, owing to the failure of the Texas crop last year, the consequent shortage of cotton available for manufacture, and the interference with use of the cotton in Mexico, owing to the disturbed conditions of that country, Mexican cotton was being exported to Britain. The first Mexican cotton began to be used at the New Ladyhouse Mill on 14th May. The incubation period of small-pox is 10 to 14 days, and the rash was first observed on the majority of these cases on the 30th and 31st May, whilst one case sickened on May 26th, five on May 27th, one on May 28th, three on May 29th and one on June 1st. This is certainly a suspicious circumstance, but the evidence does not suffice definitely to inculcate the Mexican cotton and to free cotton from the other sources from suspicion.

It may be asked, however, whether the occurrence of the small-pox cases could be explained on other grounds than that of infection conveyed by cotton from the country where it is produced. Two other suggestions seem possible—either the presence in the mill of an unsuspected case of the disease, or the handling of cotton in the early stages of manufacture by someone in an infectious condition.

I made careful inquiry as to the habits of the mill operatives with the view of ascertaining whether they came closely in contact with one another either at mealtimes or in any other way. I was informed that nearly all of them go home for dinner in the middle of the day. They are in the habit, however, of taking breakfast in the mill, though, so far as I could ascertain, there is no evidence of their congregating much together whilst partaking of this meal. They generally eat a sandwich or other light form of refreshment and drink a cup of tea sitting or standing beside the machines which they operate. I understand also, that as the majority of operatives are on "piece-work" they are glad of the respite which the breakfast half hour affords to adjust certain pieces of work so as to be in readiness when the machines are started once more, and this probably means that little time is spent in talking to one another. It would seem, therefore, that if small-pox was conveyed by personal infection it must have been by someone whose duty brought him in contact not merely with all the operatives in the main building, but also with those in the mixing and blowing rooms which are in an annexe. I was informed that the only three persons who could have fulfilled these conditions were the manager, the cardroom overlooker, and the assistant cardroom overlooker, and inquiry showed that no exception could be taken to their state of health during the past few months.

The second suggestion that cotton handled in the early stages of manufacture by someone in an infectious condition might be responsible for the outbreak can be readily dismissed as only the four men working in the mixing and blowing rooms are implicated on such a hypothesis. Three of these need not be considered as they contracted small-pox with the other operatives, leaving only one elderly man, who, though not in the best of health, had had no symptoms which were in any way suggestive of his having had small-pox.

Rochdale Case.

The following particulars relate to P. G., a man aged 24, living in the Borough of Rochdale, which the Milnrow Urban District adjoins:—

Date of onset of illness	...	Sunday, 31st May, 1914.
„ appearance of rash	...	Wednesday evening, 3rd June, 1914.
„ notification	...	„
„ removal to hospital	...	Thursday, 4th June, 1914.
„ ceased work	...	Saturday, 30th May, 1914.
Vaccination	...	Vaccinated in infancy, not re-vaccinated.

At first no connection could be traced between the Milnrow cases and this case. It was subsequently found, however, that P. G. worked in a "waste" cotton mill in Rochdale. This mill has a contract for the supply of waste cotton from the New Ladyhouse Mill at Milnrow. It was found that the last consignment of cotton waste was sent from Milnrow to Rochdale on 18th May. This included all the waste cotton which had accumulated as the result of working at the New Ladyhouse Mill for a fortnight before 18th May, it being customary to send the waste regularly once a fortnight.

Taking the incubation period as 14 days, it is evident that the Milnrow operatives must have been infected by cotton passing

through the mill on or about the 13th or 14th May, and, as already stated, the first Mexican cotton was used at the New Ladyhouse Mill on 14th May. The waste from this infected cotton was sent to Rochdale on 18th May, and would probably have been made use of on that day or a few days later. The rash appeared on the Rochdale patient on the evening of the 3rd June, 16 days after the arrival of the cotton waste from the New Ladyhouse Mill at the Rochdale Mill. It is significant, also, that P. G. was a "mixer," and was the first to handle the cotton waste at the mill. In the absence of any evidence of the existence of any antecedent case of small-pox in Rochdale, or of any exposure of P. G. to infection from a case of small-pox, it is probable that the cotton waste from the New Ladyhouse Mill conveyed infection to the Rochdale mill.

It should be explained that cotton waste consists essentially of dust removed from the blowing-room and from the carding engines. It is stated to comprise broken cotton seed, short and "dead" fibres, and a certain amount of leaf besides sand and other impurities.

Measures were promptly taken and energetically pursued in Milnrow and Rochdale to prevent the spread of infection. I gratefully acknowledge the assistance given me by Dr. Chadwick and Dr. Anderson and the Management of the New Ladyhouse Mill in obtaining the facts above recorded.

APPENDIX A., No. 7.

DR. FRANK SEYMOUR'S REPORT ON THE OCCURRENCE OF LEAD POISONING IN THE URBAN DISTRICT OF GUISBOROUGH, AND ITS RELATION TO THE PUBLIC WATER SUPPLY.

In August, 1913, Dr. W. W. Stainthorpe, senr., (of Saltburn), medical officer of health for the combined sanitary districts of Guisborough Union, reported to the Board that a number of persons in the Urban District of Guisborough were suffering from illness, the symptoms of which suggested lead poisoning. Further, the cause of this illness was ascribed to the presence of lead in the water supplied to the town.

The Board desiring some further information on the matter, I was instructed to visit the district. This I did on August 25th and on subsequent dates.

The town of Guisborough is situated in the north-east portion of the North Riding of Yorkshire, in a hollow in the northern spurs of the Cleveland Hills. It lies on the shaley beds of the lower lias. The population has grown considerably in recent years, and at the 1911 census was 7,061.

It is estimated that half the male population of the town is engaged at ironstone mines in the neighbourhood. The remainder follow such occupations as are common in a small town in a semi-agricultural district.

OCCURRENCE OF CASES OF LEAD POISONING BEFORE 1913.

I was unable to obtain any history of prevalence of lead poisoning in the district before 1909. One of the practitioners in the town, Dr. W. W. Stainthorpe, junr., of Guisborough (referred to below as Dr. Stainthorpe), has, however, given me a list of cases of illness, attributed by him to lead poisoning, that have come under his observation since that year. The numbers are as follows:—

1909	...	...	...	4 cases
1910	...	...	...	2 „
1911	...	...	..	4 „
1912	...	...	...	8 „

Special reference may be made to two of the cases. The first, coming under observation in 1909, was that of a farmer W., aged 40 at the time. He first noticed pain in right arm and leg, he was badly constipated and suffered for a time from severe abdominal pain. Subsequently he suffered from right wrist-drop, and a blue line was discovered in the lower gum. This man (although not

left-handed) is still considerably weaker in the right than in the left hand, and remains of a blue line are still visible. His wife suffered also from colicky pains, depression and weakness. She had no lead-line. In the man's case an examination of the urine showed traces of lead, in the woman's case no tests were made.

Up to this time the water used at the farmhouse where Mr. and Mrs. W. reside, and obtained from the public supply, was stored in a lead-lined tank. Water from this tank was found to contain lead. The water company replaced the tank by one of galvanised iron, and the symptoms indicative of lead poisoning in these cases have since gradually diminished.

The next case was that of a woman living in a new house also served by the public supply, where, it may be assumed, the new pipes would be especially insusceptible to the plumbo-solvent action of the water if such existed. No tests appear to have been made at the time, but in the following year (November, 1910) on the occurrence of some further cases, water from a tap in this house was analysed and found to contain about $\frac{1}{20}$ grain lead per gallon. It cannot now be ascertained whether this sample represented the ordinary supply, or was that obtained on first turning the tap after allowing the water to remain in the pipes overnight.

CASES OF LEAD POISONING OR SUSPECTED LEAD POISONING IN 1913.

In 1913, cases of lead poisoning or of suspected lead poisoning, hitherto occurring only sporadically as indicated above, were noticed in considerable numbers, so much as to produce what may be termed an epidemic during May, June and July.

Dr. Stainthorpe has given me a list of 87 cases applying to him for treatment between March and the beginning of September:—

—				Age 1-20.		Age 20-50.		Age 50 upwards		Age not stated.		Total.	
				M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
March	...	...	...	—	—	1	—	—	—	—	—	1	—
April	...	...	...	—	—	—	—	—	—	—	1	—	1
May	...	...	...	—	2	5	2	1	—	2	8	8	12
June	...	...	...	2	—	7	8	2	1	4	13	15	22
July	...	...	...	1	2	3	9	—	—	1	4	5	15
August	...	...	...	—	1	—	3	—	—	—	—	—	4
September (to 5th)	...	...	...	—	—	1	2	—	—	—	1	1	3
Total	...	...	...	3	5	17	24	3	1	7	27	30	57
Total for both sexes...				8		41		4		34		87	

Since Dr. Stainthorpe has latterly ceased recording all the suspicious cases which he sees, it may well be that the numbers of these in his practice during July, and more especially August, are greater than those given above, but he is satisfied that the prevalence of the illness has distinctly diminished since July.

Having regard to the insidious onset of lead poisoning, the date of the commencement of illness has naturally been difficult to fix in many cases. In others it roughly corresponds with the date of calling in medical aid.

REASONS FOR CONSIDERING THE CASES DUE TO LEAD POISONING.

Dr. Stainthorpe's attention was called to the matter this year in the following way. He had been himself ill for about a year with vague abdominal symptoms diagnosed by various clinicians as appendicitis or duodenal ulcer. Recollecting previous cases which he had diagnosed as plumbism, it occurred to Dr. Stainthorpe that possibly his own illness might be due to lead poisoning. Accordingly in May 1913 he caused a sample of urine to be tested by Messrs. Brady & Martin, of Newcastle-upon-Tyne. Lead was found to be present.

Dr. Stainthorpe then considered that it was quite possible that a number of cases of illness of a somewhat obscure nature which had come under his observation, characterised by neuralgic pains, headache, dyspepsia, or other indeterminate symptoms, might also be due to lead intoxication. He therefore caused a number of samples of urine to be examined, and of 24 samples sent to the same analysts as had been employed in his own case, 17 were found to contain lead.

Subsequently, the expense of having samples tested being beyond the means of many of the poorer patients, Dr. Stainthorpe obtained the use of a laboratory in Guisborough and made a large number of tests upon the urine of various persons in whom he suspected the presence of lead poisoning. He found lead to be present in 76 instances out of about 100.

In the case of three patients, samples of urine were also analysed in Newcastle for Sir T. Oliver, and lead was found in two of them, while in several other cases positive tests were made by more than one observer.

From Dr. Stainthorpe's list of cases from 1909 onward, it appears that the signs or symptoms of those attacked may be tabulated as follows :—

Colic	...	...	...	present in 77 cases.
Headache	...	...	...	72 "
Neuralgic pains	...	...	...	79 "
Anæmia	...	...	...	78 "
Blue line	...	...	...	11 "
Convulsions	...	..	..	1 "
Wrist drop	...	...	...	1 "
Ankle drop	...	...	...	1 "

I visited a large number of these cases, both those of recent occurrence and others of longer standing.

The more prominent and usual symptoms observed were :—

Abdominal pain, usually severe, extending across the lower part of the abdomen in some cases, in others across the epigastrium. This

pain was variously described as 'colicky,' 'gnawing,' or 'as if bowels were tied together.' Often it was found to be worse in bed or when hungry.

Constipation.—This was usually a pronounced symptom, although in some cases diarrhœa was found to exist. Notwithstanding the prevalence and severity of constipation, I do not think that as much weight should be attached to it as to certain other symptoms: for in a given number of persons, two thirds of whom are females, a considerable degree of constipation may exist without receiving much attention. On the occurrence, however, of other illness in the individual, constipation, till then disregarded, is likely to be brought forward as a noteworthy symptom.

In certain of the cases visited, indeed, I was informed by the patient that a state of costiveness was usual, but in others I was assured that it was a new symptom commencing at the time of the illness in question.

Headache was very common and usually of a severe character. Its site was either in the occipital region extending downwards into the neck; across the vertex; or, less frequently, in the frontal region.

Neuralgic pains were also of common occurrence among those visited. They appear more frequently to have affected the lower than the upper limb, and were often referred to the joints or to the long bones.

General weakness and inability to work were much complained of. That these are entirely subjective complaints, lending themselves readily to malingering of the crudest type, cannot be denied. On the other hand, I could hardly attribute malingering to such persons as widows who had to support themselves, or fathers of families for whom the loss of a number of days' work is serious and much felt, or women who, though accustomed to do their own house work, were unwillingly compelled to call in assistance for the performance of duties ordinarily readily carried out.

Anæmia.—The presence of anæmia alone is of little importance. It was, however, observed not only in the younger women in whom anæmia is common, but also in men, matrons and children, and I was struck, in walking through the town, by the large proportion of persons met with who appeared anæmic. This apparent prevalence, and the fact that it was often found in conjunction with other suspicious symptoms, give anæmia some diagnostic value.

Miscellaneous complaints, such as bad taste in the mouth, sweating, drowsiness and lassitude were also complained of in a number of the patients seen. Weakness of various muscles was met with, and generally many of the cases recalled the observation of the Medical Officer of the Board (Supplement to the 38th Annual Report, Appendix A., No. 10). "Apart from definite recognisable symptoms" . . . "the frequent ingestion of minute doses of lead into the system causes lassitude, inability to work, and anæmia; and is probably the cause of much inefficiency and ill-health in persons who themselves, and whose medical attendants, are unaware of the cause of the chronic ill-health from which they suffer."

Cases of serious illness.

The foregoing are the more salient and common symptoms met with among the cases investigated. There were, however, some cases of a much more grave nature, and others in which the symptoms were very slight indeed.

Among the cases of serious illness, mention may be made of the following :—

G. H. T. Male, 41. Married. One child, aged 13. Began to be troubled with vomiting in autumn of 1912. Vomiting continued at intervals and ultimately occurred after nearly every meal during part of the spring of this year. Then followed abdominal pains ; nervous irritability and inability to settle to work ; severe pains in head, getting worse towards night ; numbness of feet ; pains in hands and feet ; sleeplessness ; aphasia of a week's duration. When examined walked with the help of a stick ; had marked right ankle drop ; was considerably wasted, having lost about 2 stone since beginning of illness ; grip weak ; ptosis of right eyelid ; lachrymose ; stated that he was barely able to do any work whatever. This man had no blue line. His symptoms were suggestive of early general paralysis. I made enquiries as to possible predisposing cause of this disease, but neither from the patient himself nor from other evidence could I find any reason for supposing that the disease was, in fact, general paralysis. The urine was tested by two independent observers ; both found lead present. The patient was a copious water drinker, often drinking a glass or two of water from the tap the first thing in the morning.

Another case was that of a woman, T., who had, for about a year, suffered from epileptiform convulsions. These seizures occurred without warning, but otherwise presented the usual features of an epileptic fit. They were attributed to chronic nephritis. Subsequently she complained of neuritic pains in fore-arms. The urine contained albumin and lead. On treatment she improved and was free from seizures for one month a longer period than had elapsed between fits for some time.

A third case, A., had been ill about nine weeks at the time of my visit. She first complained of pain situated in the region of the left kidney, and also suffered severely from headache. Afterwards colic and vomiting took place. No blue line, but some suspicious discoloration along margin of lower gum. On the occasion of my first visit she was too ill to be seen. Afterwards, however, I saw her, and, although she was semi-conscious, I succeeded with some little difficulty in getting her to answer questions. I was informed that at times it was not possible to do so. Lead was found in the urine of this patient also.

On the other hand, numerous cases are included in the list furnished me, which presented only the slightest symptoms, such as localised neuritic pains. In other circumstances it is not improbable that the suspicion of lead being concerned in these cases would never have arisen ; their attribution to lead rests upon their similarity to the more pronounced cases and on the fact that many of them were found, after Dr. Stainthorpe had made a practice of testing urines in suspicious cases, to be excreting lead.

The opinion that lead poisoning was prevalent in Guisborough is thus based on the following considerations of facts brought to my notice, principally by Dr. Stainthorpe :—

- (a.) A number of cases of illness amounting to 1 per cent. of the population, presenting in the main similar features, were noticed to occur in the town at about the same time. This pointed to some common cause.
- (b.) These cases were not restricted to persons of any one age-period, sex, class or occupation.

- (c.) Some few of these cases were typical clinical examples of somewhat mild lead poisoning.
- (d.) In the majority of instances lead was found to be excreted by the urine.*

On the other hand, the following points required consideration :—

- (a.) The presence of the Burtonian line ("blue line") was infrequent. This, however, is not altogether surprising in the absence of any suspicion of inhalation of lead dust.
- (b.) The cases were of a comparatively mild nature as compared with cases of lead poisoning usually met with industrially.
- (c.) The reported cases were confined to a single practice although there are two other medical practitioners in the town. I made inquiries of these practitioners and was informed that no case which they definitely regarded as lead poisoning had come under their notice. This was in spite of the fact that their attention had been drawn to the question by the reported prevalence of the disease in the practice of their colleague. On the other hand, neither of them had caused any tests to be made for the presence of lead in the urine, although the value of such tests in doubtful cases was not disputed.

With a view of ascertaining whether in point of fact the prevalence of symptoms such as observed by Dr. Stainthorpe was restricted to his practice, I made, in company with the medical officer of health, a house-to-house visitation which extended to nearly 150 houses.

The following is an analysis of observations made :—

Houses visited	...	...	...	...	...	..	147
No one at home	...	...	...	...	...	...	21
No suspicious symptoms heard of in any inmate of the house	...	...	...	...	...	...	87
Suspicious symptoms heard of or observed in one or more inmates	...	...	...	...	...	...	39

* The significance of lead in urine should be regarded in the following way :—Lead is not normally excreted in urine, nor is it a normal constituent of the human body. When it has gained access to the body, however, it may be excreted for considerable periods of time, the general health meanwhile remaining unaffected—in fact, so long as the excretion equals the ingestion symptoms often do not occur. As soon, however, as any adventitious circumstances, such as chill, feverish illness, &c., interfere with the excretory function, then lead becomes stored up in the body and is liable to produce prejudicial effects. In other words, though the health of a person who is excreting lead by the kidney may be unaffected, yet that person is liable to suffer from symptoms of lead intoxication at any time. There is a presumption that when symptoms not incompatible with lead intoxication occur in a given individual who is actually excreting lead, then lead is the cause of the symptoms; and when the symptoms alone are themselves sufficiently marked to suggest lead poisoning, then the presence of lead in the urine may be taken as conclusively establishing the diagnosis.

In the 39 houses the "suspicious" illness heard of or observed affected some 50 persons, among whom the following symptoms, singly or combined, were reported:—

Colic or marked abdominal pain	...	...	15
Anæmia ... ..	...	...	22
Headache ... ..	...	...	16
Neuritis or neuralgic pains	...	...	7
General weakness	...	...	5
Pain in back ... ..	...	...	3

In only one case did I observe a blue line, and that a very dubious one.

I would not be understood to imply that I found definite evidence that lead poisoning had occurred in these 39 houses,* but in view of the prevalence of plumbism I considered that in each of these houses there were persons with slight maladies of which the symptoms individually were not incompatible with lead poisoning, and that these symptoms became suspicious when aggregated in the same individual. I obtained urinary specimens from eight of the most pronounced cases. In this number were included persons in the *clientèle* of each practitioner in the town: some of the patients, however, had not called in medical aid.

Further, I examined 24 women and girls, principally the latter, at a steam laundry in the town. There was a history of headaches in three and of abdominal pain in two. Anæmia in many of these persons was very marked in degree, and at least two-thirds of the number were definitely anæmic. This may in large measure be attributed to the age of most of the workers, or to the nature of the work. In one case I obtained a urinary sample.

The nine samples of urine thus collected by me were examined for the presence of lead by my colleague, Dr. G. W. Monier-Williams. Five of them were found to contain lead in amounts varying from 0.1 milligram to 0.4 milligram per litre. Lead was also found to the extent of 0.1 milligram per litre in a specimen furnished by a gentleman who had had a previous test made with positive result, but who was desirous of having the accuracy of that test put to further proof.

I also inspected 314 school-children with a view of ascertaining the presence, or otherwise, of a Burtonian line; in no case did I find it present. About 15 per cent. of the children were of a pallor suggesting anæmia.

POSSIBLE CAUSES OF THE OUTBREAK.

Lead poisoning may be due to a variety of causes, as—

- (a.) Employment in connection with the manufacture of lead compounds; in Guisborough, however, there were no manufactures.
- (b.) Constant use of lead or lead compounds, as in the case of painters, plumbers, gasfitters and others; but the

* I met with some cases in the course of this house-to-house visitation which were already included in the list given me by Dr. Stainthorpe, but these are disregarded in the above analysis.

epidemic in question was not restricted to those using lead or its derivatives in their daily work. It included all ages from four weeks to sixty-eight years, and among the number were various persons between whom not the slightest community of occupation could be traced.

- (c.) Ingestion of lead salts. This may be by means of medicine, but it is not conceivable that upwards of a hundred individuals should by any rational person be so dosed with lead salts as to produce widespread effects of the nature already described. Many of the affected, moreover, had not attended a doctor for some considerable time before the onset of the illness in question. The hypothesis is in fact so fantastic that I only refer to it because I was informed that it had been suggested in the locality. The explanation that the lead had been ingested quasi-medicinally in the form of diachylon pills may similarly be dismissed. Lead poisoning is met with in beer and cider drinkers, especially those accustomed to partake of a morning draught which may have lain overnight in lead pipes leading from cellar to counter. Aerated waters sometimes extract lead from the heads of syphons, but the distribution and history of the cases were here inconsistent with any such explanation. For the same reason the use of certain forms of cooking vessels the eating of tinned fruit, &c., could be eliminated.

In short, no supposition other than the action of an agency such as the drinking water, common to the whole community, would meet the case. The water supply was already suspect, and its relation to the prevalence of lead poisoning may now be considered.

WATER SUPPLY.

Guisborough has a constant water supply provided by the Guisborough Water Company obtained under conditions regulated by Board of Trade Orders of 1871, 1880, and 1911, made under the Gas and Waterworks Facilities Act, 1870.

Not all the houses in the urban district are on the supply, but all the houses in the town are either individually connected to the mains or have access to standpipes common to two or more houses.

The houses, or standpipes, are connected with the mains by lead pipes. In the majority of instances these average about 30 feet in length, but it is noticeable that twelve of the individuals in whom evidences of lead poisoning were found, lived in three houses situated at the distal end of the mains and having lead service pipes up to 300 feet in length.

Sources of Supply.—There are two: from a gathering ground of about 600 acres of open peaty moorland, with a small wooded area in its central portion, and from springs. The latter are situated either in the gathering ground or just outside it. The proportion of the total supply obtained respectively from surface water and from the springs cannot be stated, but is obviously liable to considerable variations. Surface water from the gathering ground is conducted by three principal streams and their tribu-

taries, augmented by cuttings, to a reservoir on the western side of Westworth Plantation, about two miles south-east of Guisborough town. The capacity of this reservoir is stated to be about 11,000,000 gallons. It is some 725 feet above ordnance datum and about 400 feet above the town, and from it the water is piped to the town by a route which is somewhat circuitous to suit the contour of the ground. The main leading from the reservoir to the town is joined, about half a mile from the reservoir, by the two spring water mains. The water from springs on the west side is first collected in a "spring service reservoir;" that from the springs on the east is conducted to the main at the same point without entering any reservoir. In its further course to the town, the mixed water in this main passes first through an apparatus for lime treatment, and secondly through "Candy" filters, to both of which further reference is made below. The average daily consumption of water is estimated at 130,000 gallons, or a little over 18 gallons per head of the population, but the meter by which the amount used to be measured has not been in working order for some time.

Ability of the untreated water to act on lead.

As regards the spring water, the analyses available, including one made for the district council by Mr. Fairley, County Analyst, in September, 1913,* do not show any reason for suspecting it of plumbo-active tendencies. It is a pure water with a comparatively high degree of alkalinity. The reservoir water, however, is by no means free from suspicion. In January, 1909, a sample of reservoir water analysed by Dr. J. C. Thresh for the water company was acid in reaction and dissolved "an appreciable quantity of lead." In February, 1911, the same analyst found the water still acid and with a slight action on lead. When tested, however, by Mr. Fairley, in September, 1913, for the purposes of the present inquiry, the reservoir water was found to be slightly alkaline and to have only a very slight plumbo-solvent action (0.70 grains lead dissolved by one gallon of the water in 72 hours).

Variations in acidity and in plumbo-solvency are to be expected in such a water on account of variations in the amount of rainfall which have occurred in the period preceding the time of analysis. I have no records of the rainfall about the time of the two first analyses referred to; but in regard to that of September last a record of the rainfall at the Cleveland Water Company's reservoir, which is about two miles distant from the Guisborough reservoir, and at a similar altitude, shows that during the summer of this year the rainfall has been below the average of the preceding 38 years. The drought was especially marked in July and August, the rainfall for these months being as little as 3.35 inches, while the average for the same months in the preceding 38 years is 6.607 inches. Indeed, records are unnecessary to demonstrate the dryness of the season, for at the time of my visit the water in the reservoir was 10 to 12 feet below the overflow weir, and the feeders were reduced to the merest trickle or to complete stagnation. The water in the reservoir was discoloured and turbid: the neck of a bottle was barely visible at a depth of 18 inches.

* See Addendum B, p. 64.

I examined such water as was to be found flowing in these feeders and found that in some cases it was acid in reaction to methyl orange. Judging from a series of four samples kindly taken for me from feeders by the medical officer of health, however, the water in them at the time did not possess any strongly marked power to dissolve lead. It is well known that in gathering grounds of this nature the first flow of the feeders after a drought is markedly acid in reaction and has considerable plumbo-solvent action, whereas at the end of a period of drought such water as remains flowing in feeders is often free from any acidity or plumbo-solveney. February of the present year was unusually dry ($48\frac{1}{2}$ per cent. below the average of the preceding 39 years), while in March and April the rainfall was $27\frac{1}{2}$ per cent. above the average. In December, 1912, the rainfall had been $58\frac{1}{2}$ per cent. below, while in January, 1913, it was $45\frac{1}{2}$ per cent. above the average. It is therefore probable that while in August the reservoir was receiving little or no acid water, in January and March of this year an unusually large amount of acid water had flowed into the reservoir from the gathering ground.

The above refers to the reservoir water alone; as already stated the Guisborough supply also contains spring water, which has a neutralising effect, but it should be remembered that if heavy rain followed drought at a period of the year when the springs were much reduced, the counteracting effect of the spring water would be relatively less.

As regards "erosive" as distinct from "solvent" action of the raw water upon lead, little information can be given: the matter had not been investigated previous to my visit. During my inquiry samples from the reservoir, and also of spring water taken from the spring service reservoir, were tested by Mr. Fairley. These showed no erosive action in one and in three days. Subsequently Dr. Monier-Williams examined for erosive action the samples from the feeders taken by the medical officer of health: all of these were found to have some erosive action, varying from 3 parts of lead per million in 24 hours to 34 parts per million in 72 hours.*

Treatment of the water in relation to ability to act on lead.

That, before 1912, the possibility of some action of the water on lead was recognised is made clear by the following considerations:—

1. The company then adopted treatment with a view to preventing such action.

2. Analyses had shown that the water as supplied to the consumers either contained lead or was capable of acting on that metal. Thus, towards the end of 1910, five analyses of water from house taps, made at the instance of the medical officer of health by Messrs. Pattinson and Stead, of Middlesbrough, showed the presence of dissolved lead in amounts varying from .007 to .049 grains per gallon. Two samples (representing respectively the mixed water from three taps in different houses, and water from the main) analysed for the water company in the early part of 1911

* See Addendum B. (C) p. 66.

by Dr. J. C. Thresh, showed no lead in solution, but the samples were reported to be "capable of acting on lead to a slight extent." Reporting on two samples taken from town mains on 28th December, 1911, Dr. Thresh said :—"The waters contain an infinitesimal and quite negligible quantity of lead, but both are capable of taking up a considerable quantity of that metal, fully $\frac{1}{2}$ grain per gallon in 24 hours."

3. A few cases of lead poisoning had occurred before 1912 which were referable to the water.* Definite complaints of the activity of the water in regard to lead were made to the Company in 1910.

4. The ability of the water to act on lead was recognised in connection with the issue of the Board of Trade Order of 1911, which contained a clause requiring treatment to prevent action on lead to be undertaken after January 1, 1914.

Treatment of the water before 1912.

According to the information supplied to me by the water company, the sole method of treatment of the water up to 1904 was by means of sand filtration, adopted for the purpose of removing organic impurities, and without reference to the question of action on lead. About that time difficulty in obtaining suitable sand was experienced, and the filters gradually fell into disuse. Two mechanical filters were then supplied by the Candy Filter Company, Limited. These filters, which were supplied for the same purpose as the sand filters, are situated close to the town, and filtration in them is carried out by means of polarite and sand. Their size is such that the total superficies of filtering surface is about $56\frac{1}{2}$ square feet. Since the average daily consumption of water is 130,000 gallons, the water must pass through the filters at an average speed of about 3 inches per minute; since the filters are 8 feet deep the water is only in contact with the filtering material for 32 minutes. In practice the water will sometimes pass through the filters much more rapidly, the demand being greater at certain times of the day than at others.

The filters are washed periodically twice a week. In order to do this the filter which is undergoing washing is necessarily thrown out of action, while a considerable proportion of the water passing through the second filter is employed to produce a back flow in the first, so that for filtering purposes about half the capacity of a single filter is all that is available at such times. The result of this is either that water drawn off immediately after the filters have been washed has been "rushed" through the filters, or that the distributing mains get partially emptied, and when refilled, any incrustation or deposit in the pipes is disturbed, rendering the water turbid.†

Treatment in 1912 and subsequently.

Two samples taken from town mains on 22 January, 1912, were found by Dr. Thresh to contain no lead in solution, but one of them was capable of dissolving about .07 grains of lead per gallon.

* See p. 48.

† This was pointed out by the Candy Filter Company in 1910. An effort has been made to counteract this tendency by washing the filters at a time when little water is likely to be drawn off in the town.

These samples were taken from the same mains as those of December 28th, which, as already stated, were strongly plumbo-active. During the interval no treatment appears to have been carried out to inhibit the action of the water on lead. In the December samples the free carbonic acid was respectively 4.62 and 3.52 parts per 100,000, and in the January samples it had fallen to 2.2 and 3.5 respectively.

Unfortunately no analysis of the reservoir water, or of the mixed but unfiltered water partly derived from the springs, was made at this time or useful information would have been obtained as to the effect of the Candy filters on the plumbo-solvent properties of the water. Unless we assume, however, that filtration actually increased the plumbo solvency,* it is clear that the reservoir water must have been in a dangerous state at the time. It is interesting to note that the rainfall in November and December, 1911, had been excessive.

In reporting on the samples taken in December, 1911, Dr. Thresh advised the Company to treat the water by the addition of lime, and acting on this suggestion the water company instituted a system of lime treatment controlled by a method of titration suggested by Dr. Thresh.

The lime treatment is applied to the mixture of spring and reservoir water at a point about half way between the reservoir and the filter house. Ground quicklime (containing 80 to 85 per cent. of caustic lime) is added by means of a hopper fixed in a small wooden tank. The amount of lime required each day is placed in this hopper. Water which enters by means of a small pipe from the main through the bottom of the hopper, percolates upward through the lime and leaves through a small hole near the top, thus filling the wooden tank which surrounds the hopper. Thence the lime-charged water is conducted back to the main and mixes with the water therein.

The tests by which the lime addition is checked and adjusted are carried out at intervals, usually weekly, and are as follows:—

A. 100 cubic centimetres of tap water are titrated with decinormal sodium carbonate solution using phenolphthalein as an indicator.

B. Another 100 cubic centimetres of tap water are titrated with decinormal sulphuric acid, methyl orange being the indicator.

If it is found that not more than one cubic centimetre of the decinormal alkali in A, nor more than 0.5 cubic centimetres of decinormal acid in B respectively are required to turn the indicator, then it is considered that the amount of lime added has been sufficient in amount. These determinations are carried out by the foreman of the water company who, although unskilled in chemical manipulations, appears to have become accustomed to this procedure, and to carry it out in a comparable manner. But the tests, however valuable they may be otherwise, are carried out solely on the treated water, and at best only show that something is wrong after the event, and some time must elapse before the error, if such exists, can be corrected.

* Such an assumption is not untenable according to some of Dr. Houston's experiments. Filtration alone may indeed increase plumbo-activity by removing from the water the vegetable slime which tends to coat the interior of the lead pipes.

I found it very difficult to trace any relation between the amounts of lime added and the reaction of the water as shown by tests. Had tests been made on the water both before and after treatment the results would have been much more valuable.

Although the quantity of lime added was supposed to be regulated by the tests suggested by Dr. Thresh, the company do not appear altogether to have depended on this method as a working basis. Thus in April of this year the acidity to phenolphthalein of 100 c.c. of the sample tap water equalled from 0.5 to 0.9 cubic centimetres of decinormal sulphuric acid, 22 pounds of lime being added daily; in July, with an acidity of 0.1 or 0.2, 50 pounds of lime were added; and in August, the acidity being still 0.2, the lime was suddenly reduced to 22 pounds.

The increase in July was no doubt made on account of the allegation that lead poisoning was prevalent; the abrupt return from 50 pounds to 22 pounds followed a suggestion made by Sir Thomas Oliver that the addition of lime had been too generous.*

As regards the amounts of lime added I compared the record of the amounts stated to have been added daily, with the amounts shown by the invoices to have been purchased. There was a discrepancy of over 25 per cent. between the totals arrived at. This may be due to occasional omission of lime treatment, or to incorrectness in taring the vessels in which the lime is measured. Moreover, I did not find any obvious relation between the amount of lime recorded as having been added, and the state of the treated water revealed by the tests made. These circumstances make it doubtful whether the addition of lime has been such as to constitute a uniform method of treatment.

If therefore, both the water and the treatment are subject to independent variations it is not unlikely that, at times, water having in a relative sense a considerable power of acting on lead may have been admitted to the town mains. It is not inconsistent with this

* Sir Thomas Oliver, who had received samples of water in July, 1913, informed the water company that he considered the untreated water was "obviously extremely dangerous," and that the treated water was considerably better but seemed somewhat beyond the margin of safety. His experiments consisted in immersing lengths of lead piping in samples of the treated and untreated water. The untreated water absorbed a comparatively large amount of lead. On adding a known amount of lime to each sample, the amount of lead absorbed by the sample of untreated water was reduced to little more than a tenth of what had been absorbed in the first experiment, while that absorbed by the sample of treated water was slightly increased. A third experiment was made by adding to the untreated water an amount of lime smaller than had been added to portion of the same sample in the second experiment, with the result that the action on lead was less than with the larger amount of lime. It is not stated what quantities of lead per gallon the figures represent, but this does not lessen the comparative value of the experiments. I have been unable to find a reference to similar experimental results. Sir Thomas Oliver also suggested that experiments should be made with a view of ascertaining whether some substance other than lime would be more beneficial. It should be added that the condition of the water supplied to the town about this time was considered satisfactory by the water company, who had received a report from Dr. Thresh on a sample of tap water sent to him on July 11th. This sample was reported to be "free from lead, and neither to erode nor dissolve the bright metal."

view that six samples of the treated water taken in the late summer, under the conditions above referred to, and analysed by Mr. Fairley, had no solvent action on lead, although as will subsequently be seen, three of them had relatively considerable "erosive" actions.

The effect of lime treatment on the lead-dissolving properties of the water.

The lime treatment is carried out to counteract an important, and usually the main cause of a water of peaty origin acting upon lead, namely plumbo-solveney due to acidity; and while the addition of lime may have been at times incomplete, it must be assumed that since the treatment was adopted the water supplied to the town was, as a general rule, distinctly less acid than in previous years, and on many or most occasions was not acid at all. But a salient point in the present inquiry is that more cases of lead poisoning have been discovered in the town since lime treatment was commenced, than had occurred during the years preceding this treatment, and probably more cases have in fact occurred.

It is difficult to account for this merely by the supposition that acid water was sometimes admitted to the town mains in spite of the treatment, and the facts suggest that during at least part of the period from February, 1912, until the date of the present inquiry, some circumstances hitherto unconsidered must have been at work which tended to increase the plumbo-active power of the water.

In this connection reference must be made to the "erosive" ability of the water in regard to lead; a property which requires particular consideration in a place like Guisborough, where great lengths of lead pipe are commonly found.

Erosive ability of the Treated Water.

As regards this property, Dr. Houston in his report to the Local Government Board on Lead Poisoning and Water Supplies (Supplement to 38th Annual Report, p. 422, Vol. II), says that lime treatment is seldom quite satisfactory except, of course, as regards removal of acidity and consequent plumbo-solveney, and sometimes "seems actually to render the water more prone to erode lead."

That the treatment to which the Guisborough water has been submitted will prevent erosion is by no means certain. As already mentioned, no experiments on this point appear to have been made prior to the present inquiry. It will be seen from the analyses reported in Addendum B.,* that of three samples of tap water taken on the 29th August, 1913, none eroded lead in 24 or in 72 hours; whereas of three similar samples taken from a tap in Bow Street on 1st September and examined by the same analyst the erosive ability was as follows:—

				Lead eroded in grains per gallon.	
				24 hours.	72 hours.
No. 6 :—	8.15 a.m.	...	...	1.40	2.31
7 :—	9.15 a.m.	...	...	1.75	3.40
8 :—	12.30 p.m.	...	...	1.05	1.22

The second of these samples was taken during the washing of the filters.

* See page 64.

Now the only known factor which had undergone alteration between the time of taking the first three samples, and the earliest sample (No. 6) of the second series was that about half an inch of rain had fallen. The lime treatment was the same in amount, yet the alkalinity of the first three samples, calculated as calcium carbonate, was 1.33, 1.30 and 1.20, while in the second three it was 0.42, 0.49 and 0.49.

If, then, in three days, during which half an inch of rain fell, the degrees of alkalinity of the water could undergo a conspicuous reduction and the erosive power could rise from *nil* to 1.40 grains per gallon, it is clear that the treatment is not at present adequate to deal with all the variations which may occur in the water and affect its action upon lead. It should, however, be noted that the degree of alkalinity and of erosive ability of moorland waters is not actually great, and the methods for their estimation may not be so perfect as to allow of undue stress being laid on apparent quantitative fluctuations.

Moreover, while it is convenient to classify the action of water on lead into "plumbo-solvent" and "erosive" action, the distinction is to some extent arbitrary and both actions may occur simultaneously. In the ordinary use of the terms the former signifies the formation of a soluble lead compound, and the latter, disintegration of the surface of the lead (particularly when bright) with the formation of a relatively insoluble lead compound which tends to fall away from the surface of the metal, leaving a fresh exposed surface ready for further action. But it must be recognised that the circumstances in which the inner surfaces of lead pipes may be disintegrated are complex, while the chemical and physical conditions which favour it do not yet appear to be fully understood. Stress is laid by some writers on the importance of the presence of free carbon dioxide in the water, which results in lead compounds which would otherwise go into solution being converted into insoluble carbonates of lead. The lime treatment may thus in this instance have exercised a prejudicial effect by removing free carbon dioxide. In the treatment of plumbo-solvent water Dr. Houston has referred to the advantage of adding a proportion of sodium carbonate as well as lime.

Examination of lead pipes.

I was able to obtain portions of lead service-pipes that had been in use in the town. These were found to contain a brown, readily-detachable deposit. Using a small circular brush such as is employed for cleaning lamp chimneys, I brushed off a considerable quantity of this deposit from the interior of pieces of the lead piping.

The piping then showed marked eating away of the lead, chiefly along the bottom of the pipe. In some cases this was very marked and had caused bursting of the pipes.

Mr. Fairley kindly analysed this powder and found it to contain about 42 per cent. of metallic lead. (The full analysis will be found on page 66.)

The piping from which this powder was obtained had been in use for many years, and it is not possible to say when the formation of the lead compounds began to take place or ceased to do so, if, indeed, it had ceased. Yet the presence of a large amount of readily-

detachable lead compound on the inside of a water pipe shows that the water has at some time, if not continuously, had marked action on the pipe. It is conceivable that the amount of this deposit, or the ease with which it is detached, may have been affected by the treatment begun in 1912, but this can merely be a matter of conjecture.

Conclusions as to the effect of the treatment begun in 1912.

Consideration of the facts set out in the foregoing pages lead to the following conjectures :—

- (a) That the treatment, though it appears usually to have been regularly applied, is not sufficiently regulated and governed by tests to constitute a treatment of uniform adequacy, and that, in consequence, water which has been insufficiently neutralised and remains plumbo-solvent may at times have found its way into the service pipes, notwithstanding the treatment.
- (b) That although the treatment may have been ordinarily sufficient, or more than sufficient to counteract any acidity or plumbo-solvent property of the water under normal or average conditions, yet it may have failed on occasions when the water attained an abnormally high degree of activity (for example, after rain-storms following prolonged drought).
- (c) That the lime treatment cannot be regarded as necessarily removing properties of the water, other than acidity, which enable it to act on lead; in particular its "erosive" properties. Indeed it is conceivable that as a result of treatment, destruction of plumbo-solveney may be more than counterbalanced by increased ability to erode lead.

GENERAL CONSIDERATIONS ON THE INQUIRY.

It has been shown that a large number of cases of illness have recently come to notice in this district, which, though usually mild and in some cases obscure in their symptoms, may be referred to lead poisoning, the occurrence and distribution of which can only be satisfactorily accounted for by assuming that the water supply was the agent by means of which the lead had been ingested.

Inquiry as to the nature and origin of the water places it under serious suspicion of having had plumbo-active properties during the period in question, but the evidence is in many respects unsatisfactory. On the one hand analyses made of samples taken at the time of my visit showed that the water then possessed little action on lead, and did not reveal the presence of lead in the water from taps served by lead pipes. On the other hand evidence was obtained of great variability in the character of the water in respect of its ability to act on lead, both before and after the supply was subjected to lime treatment. As a result, it is not possible to say with any confidence that the water will remain in the comparatively satisfactory state in which it was found at the time of the inquiry.

In order to safeguard the future and to arrive at more definite conclusions as to the best method of treatment to adopt it would be

advisable that the water company should employ a competent analyst for a period sufficient to enable him to devise and carry out a series of differential experiments. These should be made in reference both to plumbo-solveney and to plumbo-erosive ability, and extend over some considerable time, so that the nature of the water at different seasons of the year, in storm and in drought, may be fully investigated.* Laboratory experiments on different methods of treating the water should be carried out, so that not only the widest possible variations, but also the best possible treatment of this particular water may be fully ascertained. In this connection, the addition of sodium carbonate might receive attention.

It must be added, however, that the problem of treating the water so as effectively to prevent its having any action on lead is rendered more difficult by the great lengths of lead piping which are frequently met with in Guisborough. I would recommend their replacement, wherever this is practicable, by iron or suitable tin-lined pipes.

I should like, in concluding, to express my sense of indebtedness to many persons who kindly assisted me during my inquiry, and more particularly to Mr. W. Richardson, clerk to the urban district council, to Mr. J. W. Clarke, secretary to the water company, and to Dr. W. W. Stainthorpe, medical officer of health, who spared neither time nor trouble in giving me all the assistance and information in their power.

FRANK SEYMOUR.

ADDENDUM A.

NOTE ON ALTERATIONS MADE OR NOW IN PROGRESS AT THE WATER WORKS.

In addition to complaints of the water causing plumbo-solveney, many representations have recently been made that the water was unsatisfactorily filtered, being coloured, and at times odorous, especially when heated.

The water as used for domestic purposes was markedly turbid and of a yellowish colour. No doubt the dryness of the summer caused what water remained in the reservoir to be unduly discoloured, but it did not appear to me that the filtration could be considered satisfactory, or more of the colour and turbidity would have been removed. I am informed that since my visit a quantity of mud and vegetable *débris* has been removed from the exposed portions of the bed of the reservoir.

The company have now erected a third Candy filter at a site nearer to the reservoir, and more elevated than that occupied by the two filters referred to. The latter have been removed to this site, where the lime treatment will also be carried out. A meter is being erected so that the actual daily consumption of water may be known. After filtration the water will run into a

* In this connection the suggestion of Mr. Fairley (p. 65) that the water may be intermittently affected by sulphuric acid derived from iron pyrites, might receive attention. It will be remembered that Dr. Houston found very little evidence of such action in the course of his investigations of a large number of gathering grounds yielding waters liable to act on lead, although in an isolated case (Rochdale) he showed the possibility of iron pyrites being occasionally a source of serious trouble.

covered service tank of 80,000 gallons capacity. This will serve two purposes: it will act to some extent as a sedimentation tank, and it will prevent water being rapidly drawn through any of the filters while one of them is undergoing cleansing.

ADDENDUM B.

ANALYSES, 1913.

(A).—*Results of analyses of various samples of water from the Guisborough Water Company's supply, carried out by Mr. Thomas Fairley, County Analyst, in September, 1913.*

No. 1. Taken from a tap in a private house in Guisborough. The sample was taken at an early hour, the tap not having been used since the previous evening.

No. 2. Ditto.

No. 3. Ditto.

No. 4. Taken from the Guisborough Water Company's surface water reservoir.

No. 5. Taken from the Guisborough's Water Company's spring service reservoir.

No. 6. Taken from a tap in Bow Street before washing of filters.

No. 7. From same tap during washing of filters.

No. 8. From same tap about three hours after the filters had been washed.

Nos. 1 to 5 were taken by me on 29th August, and Nos. 6 to 8 were taken by George Bradford, foreman to the water company, on 2nd September.

—	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.
Total dissolved solids ...	7.19	7.61	7.02	6.84	7.81	—	—	—
Loss on ignition ...	1.40	1.68	1.77	1.66	0.28	—	—	—
Iron in solution (as Fe_2O_3)	0.44	0.28	0.33	0.79	Trace	—	—	—
Total Calcium (as CaO)...	0.99	1.02	0.96	0.60	1.77	—	—	—
Free Ammonia ...	0.001	0.002	0.001	0.003	0.001	—	—	—
Albuminoid Ammonia ...	0.004	0.007	0.005	0.009	0.001	—	—	—
Nitrates ...	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Nitrites ...	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Chlorides as Sodium Chloride.	2.54	—	2.80	2.54	2.80	—	—	—
Alkalinity as CaCO_3 (Indicator Methyl Orange.)	1.33	1.30	1.20	0.56	3.12	0.42	0.49	0.49
Lead in solution ...	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Oxygen absorbed in four hours.	0.14	—	0.16	0.19	0.01	—	—	—
Oxygen dissolved...	0.28	0.23	0.37	0.60	0.67	0.50	0.53	0.74
Smell at 100° F. ...	Faint earthy.	Faint earthy.	Faint earthy.	Faint earthy	Nil	—	—	—
Colour in Lovibonds	10 Y +	12 Y +	10 Y +	20 Y +	0.4 Y +	—	—	—
Units 2 feet (red, yellow and blue.)	4 R + 1.4 B	4 R + 1.5 B	3.2 R + 1 B	6 R + 2.1 B	0.5 B	—	—	—
Total hardness in Clarke's degrees.	2.2°	—	2.3°	1.8°	3.6°	—	—	—
Lead dissolved in one day	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Lead eroded in one day ...	Nil	Nil	Nil	Nil	Nil	1.40	1.75	1.05
Lead dissolved in three days.	0.35	0.35	0.35	0.70	Nil	0.52	Nil	Nil
Lead eroded in three days	Nil	Nil	Nil	Nil	Nil	2.31	3.40	1.22
Amount of lead in sediment from one gallon.	0.008	0.001	0.001	Nil	Nil	0.002	Nil	0.003

N.B.—The results are expressed as grains per gallon unless otherwise stated.

Remarks by Mr. Fairley.

Samples Nos. 1, 2 and 3 are marked as being taken from different consumers' taps. Their composition and general character is practically the same, except that the sediment of No. 1 contains eight times as much insoluble lead compounds as found in Nos. 2 and 3 sediments, but even in No. 1 the quantity is very minute. These samples have practically the same alkalinity to methyl orange—1.3 grains reckoned as calcium carbonate. In my experience this is quite sufficient to prevent any material action on lead, and this opinion is confirmed by the tests for solution and erosion which appear in the tabular reports, and also by the absence of lead in solution though the samples had been standing for some hours in lead pipes.

Sample No. 4 is from the reservoir outlet, and differs from the above in the much smaller proportions of calcium and alkalinity. The effect of the diminished alkalinity in increasing the plumbosolvent action of the water is well shown by the three days' test for dissolved lead. This water, however, cannot be said to have a very marked action on lead. It is very highly coloured, so much so as to be objectionable.

Sample No. 5 differs in many respects from the above. It is not a peaty water; the calcium and alkalinity are much greater, and the water has no action in lead, as shown by the three days' tests.

The analyses, and the tests for plumbosolvency and erosion, do not explain the cases of lead poisoning which, I understand, are prevalent among the consumers of this water, and I am of opinion that acid water (probably containing sulphuric acid derived from the oxidation of pyrites) is occasionally passing into the service pipes; such water would readily dissolve lead and produce the effects complained of. The increased use of No. 5, which is a water of good quality, would form an excellent antidote for such acid waters.

If feasible, the gathering grounds should be treated with an occasional lime dressing, and any stagnant pools should be filled up, especially if in the neighbourhood of shale.

Nos. 6, 7 and 8 were only partially tested. The alkalinity, calculated as calcium carbonate, is practically the same in each case and is much smaller than in Nos. 1, 2, 3 and 5. It is also slightly smaller than in No. 4.

These samples (Nos. 6, 7, and 8) have no dissolving action on lead in one day, but for the same period, each has an erosive action, this being most marked in No. 7.

For the three days' action on lead No. 6 has a dissolving action very similar to No. 4 in the previous samples. Nos. 7 and 8 have no dissolving power. As regards erosion during this period, No. 7 is the strongest, then No. 6, and lastly No. 8.*

No. 7 does not contain any lead in the sediment, and that found in the sediment of Nos. 6 and 8 is extremely minute.

* The method adopted in testing for solution and erosion was as follows:—Pieces of bright lead, "shaved," measuring $1" \times \frac{1}{2}"$ were placed in test tubes

(B.)—*Analysis, by Mr. Fairley, of sediment from the interior of lead service pipe. The sediment was obtained by brushing with a small circular bristle brush the interior of lengths of lead piping which had been allowed to dry thoroughly.*

Moisture removed at 100° C.	...	...	7.42 per cent.
Loss on ignition	...	...	18.44 „
Total lead compounds (calculated as PbO)	...	...	44.93 „
Iron compounds (as Fe ₂ O ₃)	...	...	22.10 „
Total sulphates (as SO ₄)	...	...	2.25 „
Traces of Cl, Ca, &c.	...	...	—
			95.14 per cent.

(C.)—*Result of an examination of the plumbo-solvency and erosion of four samples of water taken from feeders of the Guisborough Surface Water Reservoir on 27th September. The samples were obtained by the medical officer of health, and were examined by Dr. G. W. Monier-Williams.*

No.	Reaction of 100 c.c. of the water.	Amount of lead compound formed calculated in grains per gallon.			
		In one day.		In three days.	
		Soluble.	Insoluble (eroded).	Soluble.	Insoluble (eroded).
1	$\left\{ \begin{array}{l} 7 \text{ c.c.} \\ \frac{N}{100} \text{ H Cl.} \end{array} \right\}$	nil.	0.21	nil.	0.56
2	$\left\{ \begin{array}{l} 2.5 \text{ c.c.} \\ \frac{N}{100} \text{ H Cl.} \end{array} \right\}$	nil.	0.42	nil.	2.38
3	$\left\{ \begin{array}{l} 1.2 \text{ c.c.} \\ \frac{N}{100} \text{ Na OH.} \end{array} \right\}$	nil.	1.19	nil.	1.12
4	$\left\{ \begin{array}{l} 2.3 \text{ c.c.} \\ \frac{N}{100} \text{ Na OH.} \end{array} \right\}$	0.56	0.63	nil.	0.98

(6" × ¾") and 10 cubic centimetres of the water to be tested was poured in and allowed to remain undisturbed for one or for three days.

When no erosion took place, as shown by the clear and transparent appearance of the water, an aliquot portion was removed and the amount of lead estimated.

Where solution and erosion both took place the lead in solution was estimated by filtering an aliquot portion through a minute Swedish filter paper and estimating the lead in the filtrate. Another aliquot portion of the shaken liquid is treated so as to dissolve the eroded lead in suspension, and the total lead then estimated. The amount eroded is obtained by difference.

ADDENDUM C.

RAINFALL IN INCHES.

Table showing

- 1^o *Rainfall for each month from October, 1912, to September, 1913.*
 2^o *Average rainfall for each month. From October to March the rainfall average is for 39 years, and from April to September for 38 years.*
 3^o *The amount by which the rainfall for 1912-13 exceeded or fell short of the average in each month.*

Month.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.
1st 10 days ...	0.43	0.66	0.28	1.10	0.64	0.68	0.88	1.28	0.71	0.98	0.15	1.03
2nd 10 days ...	0.42	1.64	0.42	1.53	0.14	1.01	0.86	0.03	0.67	0.00	0.15	0.20
Remainder of month	2.03	0.63	0.50	1.19	0.27	1.07	1.53	0.31	0.60	0.61	1.46	0.41
Total rainfall for month.	2.88	2.93	1.20	3.82	1.05	2.76	3.27	1.62	1.98	1.59	1.76	1.64
Average for month	4.273	3.519	2.888	2.075	2.022	2.233	2.118	2.481	2.299	3.299	3.308	2.403
Amount by which rainfall in 1912-13 exceeded the average.	—	—	—	1.745	—	0.527	1.152	—	—	—	—	—
Amount by which the rainfall in 1912-13 fell short of the average.	1.393	0.589	1.688	—	0.972	—	—	0.861	0.319	1.709	1.548	0.763

The above table is compiled from figures supplied to the Guisborough Water Company by Mr. W. I'Anson, Manager of the Cleveland Water Company, whose reservoir is some two miles distant from the Guisborough Reservoir, and at about the same altitude. No observations had been made by the Guisborough Water Company.

APPENDIX A., No. 8.

EXTRACT from a REPORT by DR. J. E. CHAPMAN ON THE USE OF
"OBSERVATION" BEDS.

Hitherto little experience is on record of the working of observation beds and of the different ways in which they are likely to prove of service in connection with schemes for the treatment of tuberculosis; and the following information with regard to their utilization in the Sheffield scheme may therefore be of interest.

The observation beds in this city are provided in two tuberculosis hospitals belonging to the City Council and are under the control of the tuberculosis officer and his staff in respect of admission and discharge and the clinical supervision and treatment of the patients. These hospitals are under the administrative control of a medical superintendent.

The number of beds under the clinical control of the tuberculosis officers is 22, *i.e.*, 1 bed per 20,000 inhabitants. The average stay in hospital is about 19 days, so that some 400 persons can be passed through these beds annually. The beds appear to be fully used and there is frequently a short waiting list.

The accommodation for this purpose has only been available for about nine or ten months and during this period 254 patients have been dealt with.

An analysis of the admissions showed that 27 per cent. were children under 14 years of age. The diagnosis of tuberculosis in children is frequently extremely difficult and it is to be anticipated that observation beds will frequently be required for them.

One hundred and fifty-three patients or 60 per cent. of all the cases had been notified prior to admission and 101 patients had not been notified.

101 Patients not notified before admission.

(a) Forty-six patients or 18 per cent. of the total admissions were admitted for observation at the request of the practitioner in attendance. I was informed that if a practitioner had a patient in whom the diagnosis was doubtful or difficult and expressed a wish that the patient should be admitted to an observation bed he was admitted without delay and without necessarily being seen by a tuberculosis officer. The figures appear to show that where such facilities exist practitioners are not slow to avail themselves of them.

It is interesting to note that in five out of 46 patients admitted at the request of practitioners tubercle bacilli were found in the sputum on the first examination. Although the average stay of each of these patients was only eight days, the waste of effort implied by their admission suggests the desirability of arranging for the admission of patients to observation beds, as a rule, only after the sputum has been examined with negative result. Of the remainder 32 appear to have had expectoration, but 82 examinations of this resulted in the finding of tubercle bacilli in only one case, and in that case only on the fourth examination.

Thirty-one of the 46 patients were found after admission to be suffering from tuberculosis, 11 from other diseases, one a malingerer, and four cases remained undiagnosed. These results indicate the importance of tuberculosis officers maintaining a good knowledge of general medicine as well as special knowledge of tuberculosis.

(b) Fifty-five patients or 21 per cent. of all admissions were suspects, who had originally been sent to the dispensary by school medical inspectors, health visitors, &c., or who had been found in the course of routine examinations of contacts. All these patients had been examined at or in connection with the dispensary and some had been kept under observation for some time prior to admission to these beds.

153 Patients notified before admission.

(a) The diagnosis had been confirmed before admission in at least 26 patients or 10 per cent. of the all admissions. The majority of these patients were admitted in order to ascertain their suitability for sanatorium or other special form of treatment. Others were sent in to secure a few days care and observation owing to the development of a slight attack of fever or other symptom occurring during dispensary treatment.

The tuberculosis officers regard the use of these beds for emergency cases as most important. They find the occasional admission of patients for a few days into a residential institution of the greatest assistance in connection with treatment at a dispensary. Such beds would be useful *inter alia* for the treatment necessary for the maintenance of artificial pneumothorax.

(b) The remaining 127 patients or 50 per cent. of the total admissions had been notified before admission, but tubercle bacilli had not been found, but in each case it was thought to be desirable for various reasons to confirm the diagnosis before giving treatment at the expense of the community.

- (1) Some of these cases presented somewhat obscure signs; these patients were admitted in order that all possible steps might be taken to verify the diagnosis before treating the patient in a sanatorium or hospital bed.
- (2) In others there appeared to be some doubt as to whether the disease from which the patient was suffering was tuberculous. In a number of these cases a diagnosis of some other disease than tuberculosis was eventually made.
- (3) All notified cases referred to the Town Council by the guardians for treatment in a residential institution were first admitted to these beds. At present the guardians only refer insured persons for such treatment. In the majority of cases the patient was found to be suffering from well marked tuberculosis, and was forthwith transferred to another part of the hospital. In not a few cases, however, the patient was found to be suffering from chronic bronchitis or other non-tubercular disease, and was then referred back to the Guardians.

Great attention is paid to the bacteriological diagnosis of pulmonary tuberculosis; this is shown by the record of examinations of sputum. Excluding patients in whose sputum tubercle bacilli had been found prior to admission and who were not admitted for diagnosis, it appears to have been possible to secure sputum for examination in 141 cases or 56 per cent. of the total admissions to observation beds.

In 59 cases the sputum was examined once :	tubercle bacilli were found in	...	...	...	...	...	32 cases.
In 25 cases the sputum was examined twice :	tubercle bacilli were found on 2nd examination in	...	...	...	...	2	"
In 18 cases the sputum was examined three times :	tubercle bacilli were found on 3rd examination in	...	...	...	...	1	"

In 17 cases the sputum was examined four times : tubercle bacilli were found on 4th examination in	...	...	...	...	3 cases.
In 16 cases the sputum was examined five times : tubercle bacilli were found in	...	...	...	...	0 „
In 7 cases the sputum was examined six times : tubercle bacilli were found in	...	...	...	...	0 „
In 4 cases the sputum was examined seven times : tubercle bacilli were found in	...	...	...	...	0 „
In 1 case the sputum was examined eight times : tubercle bacilli were found in	...	...	...	...	0 „
In 3 cases the sputum was examined nine times : tubercle bacilli were found in	...	...	...	...	0 „
In 1 case the sputum was examined eleven times : tubercle bacilli were found in	...	...	...	...	0 „

377 examinations of sputum were made in connection with these cases and tubercle bacilli found in 38 cases.

Special measures are taken to secure specimens of sputum from children and it is instructive to note that tubercle bacilli were demonstrated in the sputum of seven out of 65 children under 14 admitted for observation.

Results of Observation.

As the result of observation 164 patients or 65 per cent. of the total patients were found to be suffering from tuberculosis and were dealt with as follows :—

Sent to sanatorium	...	...	...	...	66
„ hospital	...	...	...	...	31
„ dispensary for treatment	...	...	...	...	37
„ „ supervision (owing to the disease being quiescent).	...	...	...	...	24
„ open air school	...	...	...	...	6
					<hr/> 164

Forty-four patients or 17 per cent. were found to be suffering from some other disease than tuberculosis.

Forty-six patients or 18 per cent. were diagnosed as not suffering from clinical tuberculosis or remained undiagnosed and were transferred to the dispensary for occasional observation.

The following points appear to call for comment—

(1) The close association of these beds with the dispensary makes them particularly valuable; patients can be dealt with without delay and the tuberculosis officers gain experience which is of the greatest value in their dispensary work and which they would have no opportunity of securing had the beds been under the clinical control of an officer independent of the dispensary.

It is my confident opinion that if these beds were not under the control of the tuberculosis officers they would not be used to anything like the present extent and the accuracy of diagnosis would be materially lessened. There are obvious advantages in arranging for these beds to be situated within convenient reach of the dispensary and having them where practicable under the clinical control of the tuberculosis officer. At the least the tuberculosis officer should have access to the patients.

(2) These beds can usefully be employed for several classes of patients. Thus patients admitted for diagnosis or for the verification of diagnosis, patients admitted for observation with a view to determining the form of treatment to be given, patients commencing

some special form of treatment, patients requiring a few days' care and observation in a residential institution during dispensary treatment may all be treated in them. It does not appear to be desirable to distinguish between observation and emergency cases likely to require only a short period of treatment in a residential institution.

(3) All patients concerning whose diagnosis there is the least doubt should be watched in observation beds before being admitted to a residential institution for prolonged treatment.

Some arrangement of this kind appears to be particularly necessary in those cases where the county or county borough council undertake the treatment of all classes of case including those who have hitherto been dealt with by Poor Law Authorities.

(4) Observation beds are required for undiagnosed and for diagnosed patients, for patients having early or advanced disease, for patients of the two sexes, for children and adults; and it is therefore desirable that the beds should be provided as far as possible in single bedded rooms, so as to permit of a satisfactory classification of patients.

(5) The work in Sheffield may perhaps be held to show that a provision of beds for observation and emergency cases on a scale of 1 to 20,000 or 25,000 of the population is not excessive in areas when all classes of the community are dealt with.

In conclusion I wish to express my thanks to Dr. Rennie the tuberculosis officer for his assistance in obtaining for me the statistical and other information upon which this report is based.

APPENDIX A., No. 9.

MEMORANDUM on HEALTH VISITING; by JANET E. LANE-CLAYPON, M.D., D.Sc.

Supervision of infant welfare and health visiting in connection with the Notification of Births Act is now widespread, but since the details of the work are frequently insufficiently realised, it appears desirable that some notes regarding the main features should be set out.

The health visitor is primarily concerned with infants, but it is important that her work should be looked at from a broad point of view and should include any features which may affect the well-being of the child before or after birth.

In the first place it is desirable to emphasise the value of ante-natal work, and to indicate briefly the line which may suitably be followed at this period with a view to safeguarding the infant's life and its future welfare.

It is hoped that maternity centres, where pregnant women may seek advice and help will be established in many areas. Where there is a maternity institution, or failing this a children's hospital, it is probable that arrangements could be made for the municipal maternity centres to be established in direct connection with them.

The centre will be available for all cases, not only for those applying to the maternity institution or hospital for aid, and it is anticipated that medical practitioners may be glad to utilise the services of the doctor or visitors of the centres for cases they will themselves attend at the confinement. Ante-natal visiting will be carried out in connection with the maternity centre where one exists, since there will be many points which may suitably be supplemented by domiciliary visits. It is assumed that where ante-natal visiting is proposed in the absence of a maternity centre, satisfactory arrangements will be made for obtaining information regarding the locality of the expectant mothers. This may be accomplished by obtaining the names and addresses of pregnant women from those persons or agencies who are practising mid-wifery in the district. Where ante-natal visiting is already being carried out by any agency, co-operation with that agency, with a view to avoid overlapping, will be desirable.

The points with which domiciliary visits will be mainly concerned will include inquiry as to the presence of any conditions in the mother which may injuriously affect the progress of her confinement and the health of the unborn infant, the feeding and clothing of the mother and the hygiene of her daily life; the health visitor should make inquiry as to the preparations the mother is proposing to make, or has made for the birth, and should be prepared to give instruction as to the requirements for this event. The health visitor should also endeavour to secure the preparation of suitable clothing for the infant, and should give advice and instruction regarding the breast feeding of infants.

It is assumed that where a maternity centre exists the health visitors will be present during the consultations at the centre, and at their visits will endeavour to secure that the medical advice given there is carried out at home. Where no centre exists it will be

advisable for the health visitors to inquire into the points above-mentioned and also into such matters as the condition of teeth and bowels, and to give advice on the care of the breasts.

The health of the mother and child although largely interdependent before birth must to some extent be considered separately.

The Health of the Mother before the Birth.

Many women regard suffering during pregnancy as a natural accompaniment of this state. The condition of pregnancy should not however be regarded as pathological, but attention should rather be devoted to the prevention, and, if necessary, treatment of such ailments or minor departures from the normal which occur all too frequently among pregnant women.

In a small percentage of cases pathological conditions must be expected to supervene but the total sum of physical or mental disturbance or suffering in this numerous and important class of the community could undoubtedly be in great degree eliminated, were due attention given to the adoption of suitable hygienic measures.

The *feeding* of the expectant mother is clearly a point of considerable importance. She should be encouraged to provide nourishing food for herself, and directions as to the avoidance of unsuitable substances should be given; in this latter category such things as alcohol in any form, vinegar, pickles, &c. will be included.

The *clothing* of the mother is frequently of unsuitable type. The health visitor should bear in mind that no part of the body should be constricted by clothing, more especially in cases where there is any tendency to varicosity of veins or to oedema of the feet and ankles. Constriction above or below the knee should be avoided.

The presence of a septic focus or foci in any part of the mother's organism will be a source of danger to the infant. Decayed *teeth* or even a mild degree of pyorrhea alveolaris will be liable to affect the child detrimentally. The habit of excessive kissing of infants is to be deprecated, but it is hardly probable that it will be eliminated. Dummy teats, which at the present time are regrettably prevalent, and the teats of the feeding bottles of artificially-fed children, are unfortunately not infrequently moistened in the mother's mouth before being put into that of the child. The danger to the infant from this revolting practice, especially if carious teeth or other septic focus be present, need hardly be emphasised.

The care and condition of the breasts should be inquired into. The importance of cleanliness of the breasts is perhaps not sufficiently realised. The common practice of "hardening" the nipples with alcohol before the confinement is not desirable and cracked nipples may best be avoided by strict attention to cleanliness and the application of some emollient or of friar's balsam. The difficulty attending breast-feeding consequent on the condition of depressed nipples may be aided by pulling them outwards during the later months of pregnancy.

Constipation is a common trouble among pregnant women and should be carefully dealt with. The occasional dose of castor oil, or of some other powerful aperient cannot be considered satisfactory. Efforts should first of all be made to relieve the condition by care as to the diet of the expectant mother. Fruit and vegetables (the latter mixed with oil, if necessary) and a sufficient intake of fluid and moderate exercise should be advised. If these measures fail it may

be necessary to resort to aperients.* These should be taken in small daily doses to ensure regularity of action rather than in larger but less frequent doses.

The actual drug used will vary with the individual, but it is probable that some form of saline aperient will be found applicable in the majority of cases.

Sanitation.—The sanitary condition of the home, its order and cleanliness are matters of much importance, and should on no account be neglected by the health visitor in her ante-natal visiting, as well as later.

Preparation for the infant.—The continued efforts of health visitors, both municipal and voluntary, to secure more suitable clothing for infants has undoubtedly led to considerable improvement, in most areas where this work is energetically carried on.

It is not unusual, however, for little preparation to be made for the clothing of the expected infant, or, if made, it may be of unsuitable type.

There is a tendency to pay more attention to the clothing of the child after the early weeks of life. This is clearly erroneous since the greatest care will be required immediately after birth.

The thin cotton shirt for newly-born infants and garments leaving the arms bare still persist in many areas, as does also the heavy, but not warm, flannelette petticoat or dress with cotton bodice or lining, for children after the first weeks of life.

Suitable advice as to the clothing of the infant given before birth, may secure great improvements in the matter, since it is generally found that the mother is more ready to provide satisfactory clothing than to change from unsatisfactory garments to those recommended by the health visitors after the confinement.

It is essential that advice as to the importance of breast-feeding should be given. The value of supplying the infant with the food designed for it by nature need hardly be pointed out.

It has been shown by numerous observers that the milk of the same species, while of great value throughout the whole period of suckling, is very specially so during the early days of life. Even where circumstances may render it necessary for the infant to be weaned during the early weeks of life the mother should be by all means encouraged to give the infant the breast for the longest possible period. No difficulty is experienced in the subsequent early weaning, as is sometimes supposed.

The need for regular feeding should also be discussed with the expectant mother; if possible she should be persuaded to accustom the infant from birth onwards to feeding periods which should not be less than three hours apart, and the feeding should be entirely intermitted between from 10–11 p.m. to 5–6 a.m. Those who have practised these methods of feeding have found by experience that greatly superior results are obtained than by the methods of more frequent feeding.

Breast-feeding, even if difficult, should not be entirely abandoned for three or four weeks. The difficulty is frequently due to the infant, which is not sufficiently strong to supply the necessary stimulus to the mammary gland which is required for the adequate fulfilment of its function.

Only in comparatively rare cases can the deficiency of the mammary function be attributed to a real defect on the part of the mother, unless she is suffering from insufficiency of food.

* It may be mentioned that the common idea that vegetables and fruit should not be eaten during the early weeks after confinement is without foundation.

II. *Health of the infant. Post-natal visiting.*

The first visit after birth is paid at varying periods (from 1 to 21 days after). In the county boroughs the health visitors are frequently inspectors of midwives, and they visit the infants as soon as possible after the receipt of the notification in order to assist the supervision of the work of the midwives.

In other areas it is usual for the first visit to be paid after the attendance of the doctor and midwife has ceased. Where the sanitary conditions and the clothing of the infant have received due care before the birth of the child, the most important matter for the first visit will be the feeding of the infant.

In subsequent visits the sanitation and cleanliness of the home should be kept in view, as also any alteration in the clothing and feeding of the child, as the early months and years of life are reached.

Many of the children visited will doubtless be attending the maternity centre, and it will be the duty of the health visitor to attend at the centre and secure the carrying out of the advice which is given there.

The frequency of the re-visits to the child's home will depend upon the nature of the case. In the larger towns it has been found that the average number of visits required by an infant during the first year of life is from 8 to 10 : on this average some have received less and others many more than the average.

This figure does not include ante-natal visits ; or visits between the ages of 1 and 5 years, which will also vary in frequency according to home conditions.

Qualifications of the health visitor.

It will be seen from the foregoing that the work required of a health visitor is of a varied type and demands an equally varied training.

The main branches of knowledge required will be sanitation, infant hygiene, and midwifery.

The most suitable training will be included in the work required for the examination of an inspector of nuisances, for the certificate of the Central Midwives Board, and in the course of a nurse's training.

Where possible all these qualifications should be obtained ; in any case the certificate of the Central Midwives Board should be required when any ante-natal visiting is to be done by the health visitor and this qualification is very desirable for all work connected with the hygiene of women and children.

Municipal health visitors work under the medical officer of health for the district. It is essential that the medical officer of health should be in close touch with the daily work of the health visitor and should personally direct her work.

Where, as will frequently be the case, the medical officer of health and the doctor at the maternity centre are different persons, it is desirable that arrangements should be made whereby all records both of ante- and post-natal visits as also the medical records of the centre should be on a uniform basis ; and arrangements should also be made for the health visitor to visit such special cases as may be desired by the medical officer of the centre.

APPENDIX A, No. 10.

* SUMMARY of the WORK of INSPECTORS in the MEDICAL DEPARTMENT during the year 1913-14.

A.—ACUTE INFECTIOUS DISEASE.

The following sanitary districts were visited with special reference to outbreaks of infectious diseases, viz. :—

Name of District.	Nature of Inquiry.
†Ambleside, U.D.	Poliomyelitis.
†Barrow-in-Furness, C.B.	Do.
†Beckenham, U.D.	Diphtheria.
Bridport, R.D.	Small-pox.
†Camberwell, Met. B.	Diphtheria.
†Croydon, C.B.	Do.
†Dalton-in-Furness, U.D.	Poliomyelitis.
†Dorchester, U.D.	Diphtheria.
†Kendal, U.D.	Poliomyelitis.
†Kenilworth, U.D.	Enteric fever.
†Lambeth, Met. B.	Diphtheria.
†Lewisham, Met. B.	Do.
†Luton, U.D.	Do.
Oldham, C.B.	Small-pox.
Pattingham, R.D.	Enteric fever.
†Penge, U.D.	Diphtheria.
Prescot, U.D.	Enteric fever.
†Rochford, R.D. (Great Wakering)	Diphtheria.
Royton, U.D.	Small-pox.
Runcorn, U.D.	Enteric fever.
†Sherborne, U.D.	Diphtheria.
†Sunderland, R.D.	Scarlet fever.
†Ulverston, R.D.	Poliomyelitis.
† „ U.D.	Do.
†Wincanton, R.D.	Enteric fever.
†Winsford, U.D.	Diphtheria.
†Woodbridge, R.D.	Scarlet fever.
†Worthing, U.D.	Diphtheria.

B.—TUBERCULOSIS.

In addition to a large number of conferences at office, the following local conferences were held :—

Blackburn, C.B.	Cumberland.
Bolton, C.B.	Durham Co.
Bradford, C.B.	Herefordshire.
Burnley, C.B.	Huddersfield, C.B.
Bury, Jt. H.D.	Kensington, Met. B.
Chelsea, Met. B.	Kent.
Chester, C.B.	Lancashire.
Croydon, C.B.	Leeds, C.B.

* Throughout this summary the following abbreviations are used :—C.B. = County Borough ; Met. B. = Metropolitan Borough ; U.D. = Municipal Borough or Urban District ; R.D. = Rural District ; P.S.D. = Port Sanitary District ; Jt. H.D. = a Joint District for hospital purposes formed under the Public Health Act, 1875, or the Isolation Hospitals Acts, 1893 and 1901.

† See Appendix A, No. 11.

‡ See Appendix A., No. 3.

B.—TUBERCULOSIS—*continued*.

Liverpool, C.B.	Rotherham, C.B.
Marylebone, Met. B.	Rutland.
Middlesbrough, C.B.	Salford, C.B.
Newcastle-upon-Tyne, C.B.	Somersetshire.
Nottingham, C.B.	South Shields, C.B.
Nottinghamshire.	Staffordshire.
Oldham, C.B.	Warrington, C.B.
Peterborough, Soke of.	West Hartlepool, C.B.
Plymouth, C.B.	Yorkshire, W.R.
Preston, C.B.	

For the purpose of approval under section 16 (a) of the National Insurance Act, the number of dispensaries and dispensary sites visited was 150, and of sanatoria and hospitals, and sites therefor, 239.

C.—INFANT MORTALITY AND CHILD WELFARE.

An investigation was made into the causes of infant mortality in Burnley, C.B., Colne, U.D., Farnworth, U.D., Nelson, U.D., Stretford, U.D., Widnes, U.D., and Wigan, C.B. A report on this investigation was presented to Parliament [Cd. 7511].

Dr. Janet Lane-Claypon visited the following districts as to administration of the Notification of Births Act, 1907, or child welfare work generally :—

Aberdare, U.D.	Liverpool, C.B.
Ashton-under-Lyne, U.D.	Llanelly, U.D.
Barrow-in-Furness, C.B.	Long Eaton, U.D.
Batley, U.D.	Lyme Regis, U.D.
Birmingham, C.B.	Manchester, C.B.
Bradford, C.B.	Merthyr Tydfil, C.B.
Breconshire.	Montgomeryshire.
Cardiff, C.B.	Nottingham, C.B.
Carlisle, U.D.	Oldbury, U.D.
Chesterfield, U.D. and R.D.	Radnorshire.
Coventry, C.B.	Redditch, U.D.
Denbighshire.	Rhondda, C.B.
Derby, C.B.	Salford, C.B.
Derbyshire.	Sheffield, C.B.
Dewsbury, C.B.	Staffordshire.
Dudley, C.B.	Stafford, C.B.
Finsbury Met. B.	Stalybridge, U.D.
Gravesend, U.D.	Stoke-on-Trent, C.B.
Halifax, C.B.	Swansea, C.B.
Hitchin, U.D.	Wakefield, C.B.
Huddersfield, C.B.	Warwickshire.
Ilkeston, U.D.	Watford, U.D.
Kensington, Met. B.	Whittington and Newbold, U.D.
Leamington, U.D.	Worcestershire.
Leeds, C.B.	Worcester, C.B.
Leicestershire.	Workington, U.D.
Leicester, C.B.	Wrexham, U.D.

D.—SANITARY ADMINISTRATION.

The following sanitary districts were visited with reference to general sanitary circumstances and administration :—

†Dartmouth, U.D.	†Padiham, U.D.
†Eye, U.D.	†Poole, U.D.
†Hayfield, R.D.	Whitby, R.D.
Marlborough, U.D.	†Wimborne, U.D.
Do. R.D.	†Wincanton, R.D.
Midhurst, R.D.	†Wortley, R.D.

E.—HOUSING.

The following sanitary districts were visited by medical inspectors with special reference to housing :—

†Aberayron, U.D.	Marlborough, R.D.
†Alvaston and Boulton, U.D.	Mildenhall, R.D.
Axminster, R.D.	†Padiham, U.D.
†Barnoldswick, U.D.	†Ruthin, R.D.
†Bowland, R.D.	†St. Neot's, R.D.
Crickhowell, R.D.	†Sedbergh, R.D.
†Dartmouth, U.D.	†Settle, R.D.
†Earby, U.D.	†Silsden, U.D.
†Edeyrnion, R.D. (Corwen).	†Skipton, U.D.
†Geirionydd, R.D. (Penmachno).	†Do. R.D.
†Glossop Dale, R.D.	†Tetbury, U.D.
†Hambledon, R.D.	†Do. R.D.
†Lleyrn, R.D.	†Wells, U.D.
Marlborough, U.D.	†Wimborne, U.D.

A visit was paid to Merthyr Tydfil respecting the accommodation provided for workmen employed on the Taff Fechan Waterworks.

F.—HOSPITALS, &C.

Local inquiries were held as to the provision of isolation hospital accommodation in connection with the following districts :—

Bangor, U.D.	Hitchin, R.D.
Barrow-in-Furness, C.B.	Lowestoft, U.D.
Bourne, R.D.	Mansfield, U.D.
Bradford, C.B.	Normanton and District,
Bradwell, Jt. H.D.	Jt. H.D.
Bridlington, U.D.	Northfleet, U.D.
Buckingham, R.D.	Oundle, U.D. & R.D.
Cambridge, U.D.	Petersfield, H.D.
Christchurch, R.D.	Portsmouth, C.B.
Conway and Penmaenmawr,	Ripon, R.D.
Jt. H.D.	Saffron Walden, Jt. H.D.
Devonport, C.B.	Shipley, U.D.
Doncaster and Mexborough,	Southampton, C.B.
Jt. H.D.	Stoke-on-Trent and Stoke
Easington, R.D.	Rural, Jt. H.D.
Fylde, Preston and Garstang,	Sunderland, R.D.
Jt. H.D.	Wallingford and Crowmarsh,
Gillingham, U.D.	Jt. H.D.
Gower and Oystermouth, H.D.	Wath, R.D.
Hebburn, U.D.	Wharfedale Union, Jt. H.D.
Hemel Hempstead, Jt. H.D.	Wimbledon, U.D.

Inquiries were also held as to the provision of hospital or dispensary accommodation for tuberculosis in :—

Auckland, Shildon and	Halifax, C.B.
Willington, Jt. H.D.	Middlesbrough, C.B.
Cornwall.	St. Helens, C.B.
Croydon, C.B.	Salford, C.B.
Devonshire (East Stonehouse).	Warrington, C.B.
Eastbourne, C.B.	West Ham, C.B.

Also as to the provision of a mortuary and post-mortem room for Newcastle-on-Tyne, C.B.; of a laundry and disinfecting apparatus for Lymm, U.D.; of disinfecting apparatus for Sheerness, U.D., and Wednesbury, U.D.; as to the issue of Provisional Orders for the inclusion of Sunderland, C.B., in the N.E. Durham Joint Small-pox H.D., and for the formation of Halstead, U.D. and R.D., into a Jt. H.D.; also as to appeals by certain of the constituent district councils against the Wellington (Salop) Jt. H.D. Order.

Informal visits were made to Ashton-in-Makerfield, U.D., Birmingham, C.B., Bradford, C.B., Brixham, U.D., Brownhills, U.D., Burton-on-Trent, C.B., Bury, Jt. H.B., East Ham, C.B., Frimley, U.D., Glanford Brigg, R.D., Halstead, U.D. and R.D., Leake, R.D., Morpeth, R.D., Preston, C.B., Repton, Jt. H.D., Rotherham, C.B., Rugby, R.D., Sleaford, U.D., Sunderland, C.B., Tottenham, U.D., and West-houghton, U.D., as to hospital accommodation.

Inquiry was made as to the administration of the Belper Joint Hospital, the Bicester U. & R. Hospital, and the Bromley and Beckenham Joint Hospital.

G.—SEWERAGE AND SEWAGE DISPOSAL.

Inquiries in this connection were made as follows :—

Cockermouth, R.D. (Dearham).	Northallerton, R.D. (Csmo-
Loughborough, R.D. (Hathern).	therley).
Maidstone, R.D.	

H.—WATER SUPPLY.

Inquiries were made as to water supply in the following districts :—

Bedwelty, U.D.	Maryport, U.D.
East Cowes, U.D.	Mildenhall, R.D.
Kingsbridge, R.D. (Modbury	Misterton, R.D.
and Kingston).	Northallerton, R.D. (Osmeth-
Loughborough, R.D. (Hathern).	erley).
Macclesfield, U.D.	Worcester, C.B.

I.—SCAVENGING.

Under this head inquiries were made in :—

Aylsham, R.D.	Prudhoe, U.D.
Barnard Castle, R.D.	Startforth, R.D.
Clutton, R.D.	Uppingham, R.D.
Cockermouth, R.D. (Dearham).	Westbourne, R.D.
Neath, R.D.	

J.—BYELAWS AND REGULATIONS.

Inquiries with reference to byelaws and regulations were made in :—

Chelmsford, R.D.	London Co.
Cookham, R.D.	Romford, R.D.
Dewsbury, C.B.	Sandwich, U.D.
Folkestone, U.D.	South Stoneham, R.D.
Guildford, U.D.	Tainworth, R.D.
Huddersfield, C.B.	Weston-super-Mare, U.D.
Liverpool, C.B.	

K.—VACCINATION INSPECTION.

During 1913-14 the medical inspectors made routine visits to 130 unions and reported on administration under the Vaccination Acts, 1867 to 1907.

Grants were made to 634 public vaccinators under Section 5 of the Vaccination Act, 1867, the total sum awarded being £14,569 11s.

Number of Unions Inspected.	Number of Vaccination Districts in the Unions.	Number of Public Vaccinators Recommended for Award.	Total Sum Awarded.	Medical Inspector.
			£ s. d.	
1	4	3	15 7 0	Dr. Arnold.
4	32	31	2,189 5 0	„ Carnwath.
15	75	74	551 0 0	„ Copeman.
10	50	51	1,048 3 0	„ Farrar.
21	91	83	5,183 12 0	„ Fletcher.
13	107	98	789 17 0	„ Hutchinson.
1	2	3	8 5 0	„ Macewen.
3	22	16	604 3 0	„ Manby.
10	78	69	875 14 0	„ Mivart.
19	113	84	1,452 6 0	„ Prior.
3	10	7	56 17 0	„ Morgan Rees.
13	71	42	356 0 0	„ Seymour.
17	80	73	1,439 2 0	„ Sweeting.

In addition to the routine inspection of vaccination, special visits by medical inspectors with reference to vaccination administration were made to eleven unions.

L.—CONFERENCES WITH LOCAL OFFICIALS.

Conferences on sanitary matters were held locally with various officials of the following districts :—

Aberayron, U.D. & R.D.	Bishop Auckland, U.D.
Alford, U.D.	Blackburn, R.D.
Axminster, R.D.	Bracebridge, U.D.
Barton-on-Humber, U.D.	Branston, R.D.
Basingstoke, U.D. & R.D.	Bromley, R.D.
Biddulph, U.D.	Burnley, C.B.
Billerica, R.D.	Caistor, R.D.
Billesdon, R.D.	Camberwell, Met. B.

L.—CONFERENCES WITH LOCAL OFFICIALS—*continued.*

Carnarvonshire, Combined District.	Misterton, R.D.
Chippenham, R.D.	Mitford and Launditch, R.D.
Chorley, U.D.	Newcastle-upon-Tyne, C.B.
Clayton-le-Moors, U.D.	New Hunstanton, U.D.
Clayton West, U.D.	Newport (I. of Wight), U.D.
Cockermouth, R.D.	Oldbury, U.D.
Cranbrook, R.D.	Penmaenmawr, U.D.
Crook, U.D.	Pwllheli, U.D.
Croydon, R.D.	Romford, U.D. & R.D.
Dalton-in-Furness, U.D.	Roxby-cum-Risby, U.D.
Derby, C.B.	Runcorn, U.D.
Doncaster, R.D.	Ruthin, R.D.
Ealing, U.D.	St. Asaph (Denbigh), R.D.
Eastry, R.D.	Shildon and East Thickley, U.D.
East Westmorland, R.D.	Skegness, U.D.
Edeyrnion, R.D.	Southborough, U.D.
Ely, R.D.	Stockton, R.D.
Eton, R.D.	Stoke-on-Trent, R.D.
Featherstone, U.D.	Sturminster, R.D.
Filey, U.D.	Surbiton, U.D.
Finsbury, Met. B.	Sutton Coldfield, U.D.
Forehoe, R.D.	Tamworth, U.D. & R.D.
Grimsby, R.D.	Tilbury, U.D.
Guildford, R.D.	Todmorden, U.D.
Harrow-on-the-Hill, U.D.	Ulverston, R.D.
Hartismere, R.D.	Upholland, U.D.
Hayes, U.D.	Valley, R.D.
Hetton, U.D.	Wadebridge, U.D.
Houghton-le-Spring, U.D.	Wakefield, C.B.
Hoxne, R.D.	Wanstead, U.D.
Kensington, Met. B.	Warrington, R.D.
King's Lynn, R.D.	Weardale, R.D.
Ledbury, U.D.	Welton, R.D.
Leyland, U.D.	West Ham, C.B.
Long Ashton, R.D.	Westmorland, Co.
Looe, U.D.	Wharfedale, R.D.
Lydd, U.D.	Whittlesey, R.D.
Malmesbury, U.D. & R.D.	Wiltshire, Combined District
Marlborough, R.D.	Wincanton, R.D.
Methley, U.D.	Wirral, R.D.
Millom, U.D.	Yeovil, U.D.

M.—MISCELLANEOUS.

Dr. Copeman continued inquiries on the part played by flies in spreading infectious disease, and into the nature, &c., of ferro-chrome and other ferro-alloys. He gave evidence with reference to cow-pox before the Departmental Committee on Compensation for Industrial Diseases.

Dr. Fletcher represented the Board on the standing joint Inter-Departmental Committee dealing with matters of common interest to the Local Government Board, Home Office and Board of Trade.

Dr. Johnstone represented the Board on the International Health Office Committee in Paris. He concluded his investigation as to venereal diseases and gave evidence before the Royal Commission

appointed to enquire into the subject. He made a sanitary survey of Harwich, Hull and Goole, and Tyne ports, chiefly as to the inspection of ships coming from foreign ports, and visited the Victoria Docks as to the precautions taken against the possible landing of plague-infected rats. He also held an inquiry respecting the proposed appointment of a medical officer of health for a combination of districts in Wiltshire.

Dr. Manby held an inquiry, in conjunction with an engineering inspector, respecting the proposed removal from office by the U.D.C. of the medical officer of health of Ilford.

Dr. Farrar visited a number of districts in Kent, Worcestershire, Herefordshire and Sussex, respecting the accommodation provided for hop-pickers.

Dr. Coutts attended, as a representative of the Board, certain of the meetings of the Welsh National Memorial Association for the Prevention of Tuberculosis.

Dr. Spencer Low made an inspection of the docks of the Port of London Authority with regard to their accessibility to rats.

Dr. Seymour investigated an occurrence of lead poisoning in Guisborough, U.D., and its relation to the public water supply (*see* Appendix A., No. 7.) He also visited a number of cinematograph theatres in London regarding their sanitary condition.

Mr. Fremlin made inquiries respecting a case of cow-pox in Keynsham, R.D.

N.—INQUIRIES BY THE ASSISTANT INSPECTOR IN THE MEDICAL DEPARTMENT.

Mr. Huddart inquired into the arrangements for the performance of the duties of inspector of nuisances and vaccination officers in a number of districts.

O.—FOOD SUB-DEPARTMENT.

The work of the food inspectors is summarised on pages 104 to 115.

P.—PATHOLOGICAL LABORATORY.

The work of the medical inspector and laboratory assistants in this laboratory is summarised on page 118.

Q.—GOVERNMENT LYMPH ESTABLISHMENT.

A report on the operations of the Establishment is contained on pages 116 and 117.

APPENDIX A., No. 11.

ABSTRACT of MEDICAL INSPECTIONS made in the year 1913-14 with regard to the INCIDENCE of DISEASE on particular places, and to questions concerning LOCAL SANITARY ADMINISTRATION.

[Where price is given the report can be obtained either direct or through any bookseller from Messrs. Wyman & Sons, Ltd., 29, Breems Buildings, Fetter Lane, London, E.C.]

1. ABERAYRON URBAN DISTRICT (CARDIGANSHIRE); population (1911), 1,342; Dr. Morgan Rees.

Authority concerned: Aberayron Urban District Council.

Ground of Inquiry: Housing of the Working Classes; necessity for action under Part III. of the Housing of the Working Classes Act, 1890.

Chief Facts reported by Inspector: Popular seaside summer resort. A few houses unfit for human habitation. On the whole, housing conditions are good. Demand for a good common lodging-house.

Chief defects of district are absence of good water supply and of all drainage and sewerage, the water supply being dependent upon shallow wells and springs which are liable to surface pollution.

2. ALVASTON AND BOULTON URBAN DISTRICT (DERBY); population (1911), 1,398; Dr. T. Carnwath.

Authority concerned: Alvaston and Boulton Urban District Council.

Ground of Inquiry: Paucity of information in the annual reports of the medical officer of health.

Chief Facts reported by Inspector: The greater part of this district was incorporated with Derby in 1902, and what is now left is the tag end of a residential suburb. On the outskirts is a group of comparatively new artisans' dwellings of fair plan and appearance but cheap construction, known as Allenton. Within the last year or two there has been some building along the Kegworth Road. Housing conditions are fairly satisfactory: defects, where found, were of the usual kind—bad floors, lack of larder, scullery, proper closet and ashpit accommodation, the common yard, &c. There is no scarcity of houses for people belonging to Alvaston, but any new houses which are built are readily taken by artisans and others from Derby: there is no overcrowding: rents are moderate: land is said to be obtainable at reasonable cost.

Improvement in the water supply is called for, many of the existing wells being liable to pollution: housing inspection is being inefficiently carried out and records are unsatisfactory: generally, administration is lax.

3. AMBLESIDE URBAN DISTRICT (WESTMORLAND). See No. 26.

4. *ASHINGTON URBAN DISTRICT (NORTHUMBERLAND); population (1911), 24,583; Dr. R. Farrar. [New Series, No. 87, Price 4d.]

Authority concerned: Ashington Urban District Council.

Ground of Inquiry: Prevalence of enteric fever.

Chief Facts reported by Inspector: Enteric fever has been unduly prevalent in the urban district since 1901. Dr. Darra Mair reported on an outbreak involving 191 cases in 1901; 157 cases occurred in the years 1903-10; there was a severe recrudescence of the disease in the autumn of 1911. Special investigation was made of the 89 cases that occurred during the period 1st April, 1911, to 7th June, 1912. Analysis shows that not only during the recent epidemic, but in previous years there has been a special incidence of the disease on men and boys employed in the coal mines, 49·3 per cent. of cases occurring during the whole period being males of mining age, and 50·7 per cent. females and children. During the recent outbreak there has also been a special incidence on men and boys employed in the Ashington pit as compared with the other pits worked by the same company. Several of the cases among females and children were secondary cases. Special incidence also occurred in the "rows" at Ashington, and particularly Ninter Row, as compared with other parts of the district.

The privy midden system prevails throughout the entire district, and particularly in the "rows" at Ashington, the privy middens are of unsatisfactory type, unduly large, and not properly covered in. It seems likely that the incidence of the disease is due in the first instance to some condition, probably the use of infected water, operative in the pits, and that the unsatisfactory methods of excrement and refuse disposal are responsible for its secondary diffusion.

The "dual" supply of "slop" water and water for household purposes is unsatisfactory, and a better water supply is needed.

The hospital is inadequate and of unsatisfactory design. It was seriously overcrowded during the recent outbreak.

5. BARNOLDSWICK URBAN DISTRICT (YORKS, W.R.): population (1911), 9,703; Dr. T. Carnwath.

Authority concerned: Barnoldswick Urban District Council.

Ground of Inquiry: Housing conditions.

Chief Facts reported by Inspector: Rapid growth of population; building not keeping pace with industrial expansion. There are practically no vacant houses; rents are high, and overcrowding is not uncommon. A large number of houses are referred to as being either unfit for human habitation or not "in all respects reasonably fit." Inspection under section 17 (1) of the Act of 1909 requires to be accelerated. One of the chief defects is the crowding of houses on area; the advisability of preparing a town planning scheme is suggested with a view to the avoidance of such congestion in the future.

* Inspection made in 1912-3.

The need for a scheme under Part III. of the Act of 1890 is urged, also the need for improvement in the closet accommodation, and in the storage and collection of house refuse.

6. BARROW-IN-FURNESS COUNTY BOROUGH. *See* No. 26.
7. BECKENHAM URBAN DISTRICT (KENT). *See* No. 43.
8. BOWLAND RURAL DISTRICT (YORKS, W.R.); population (1911), 5,357; Dr. T. Carnwath.
Authority concerned: Bowland Rural District Council.
Ground of Inquiry: Housing conditions.
Chief Facts reported by Inspector: Many old houses approaching the border line of the "unfit": few have damp-proof courses and means of ventilation are not always satisfactory; the lighting area is rarely up to modern requirements; there is much room for improvement in the condition of yards and in the means of storage of house refuse. There is evidence of scarcity of housing accommodation in some of the eastern parishes, particularly Gisburn and Rimington. Attention is drawn to the want of sewerage in Slaidburn and Grindleton, and the need for a proper water supply in Slaidburn and Newton: improvement in the water supply of Bolton-by-Bowland is also called for.
9. CAMBERWELL METROPOLITAN BOROUGH. *See* No. 43.
10. CORWEN PARISH (MERIONETH); population (1911), 2,856; Dr. Morgan Rees.
Authority concerned: Edeyrnion Rural District Council.
Ground of Inquiry: Complaint from a resident alleging scarcity of houses in the parish of Corwen.
Chief Facts reported by Inspector: Crowding together of houses in town of Corwen; houses built back-to-back and back-to-earth; over-and-under houses.
 Overcrowding of people in houses. Houses in bad repair, floors broken; stairs dilapidated, walls damp. Demand for decent houses.
 [The Board subsequently received a formal complaint under section 10 of the Housing, Town Planning, &c. Act, 1909, signed by four inhabitant house-holders in the rural district. After an informal conference with the council, the council unanimously resolved to provide additional houses for the working classes in the town of Corwen.]
11. CROYDON COUNTY BOROUGH. *See* No. 43.
12. DALTON-IN-FURNESS URBAN DISTRICT (LANCASHIRE). *See* No. 26.
13. DARTMOUTH BOROUGH (DEVON); population (1911), 7,005; Dr. F. St. George Mivart. [New Series, No. 90, Price 4d.]
Authority concerned: Dartmouth Town Council.
Ground of Inquiry: Unsatisfactory replies from the town council to letters on the subject of isolation hospital provision; insufficient information in the medical officer's annual report as to sanitary conditions in the town; inspections under Housing Regulations (1910) not carried out; report that a member of town council had been appointed inspector of nuisances.

Chief Facts reported by Inspector: Housing accommodation very bad and insufficient. "Tenement houses" are the feature of the town, nearly all of them being houses formerly inhabited by a more prosperous class. Houses huddled together against steep hill sides, with little ventilation and light. General conditions of rooms, staircases, and passages bad. Great demand for "single" or "separate" houses.

Two public water services, one from the mains of town council, the other from those of the Feoffees of St. Petrox. Former derived from six different sources, which need attention to exclude contaminating matter; filtration also requires improvement. House drainage needs careful investigation—numerous filth nuisances discovered. Insufficient provision of closet accommodation. Refuse disposal arrangements unsatisfactory. Dairies, Cowsheds and Milkshops Order not properly enforced. Conditions of cowhouses bad. Very bad conditions found in bakehouses.

In January, 1913, the town council elected as inspector of nuisances one of their own members who had resigned specially to become candidate for the office and who was elected in preference to 108 other candidates. The elected inspector of nuisances unpossessed of any sanitary certificate or previous public health experience.

Temporary hospital provided for cases of infectious disease of little use, and further expenditure upon this structure of doubtful utility. Necessity for combination by several other districts with Dartmouth to provide adequate hospital accommodation. Disinfection arrangements unsatisfactory. A current steam disinfecter kept in surveyor's yard, adjoining public garden, and accessible by public. No special accommodation for smallpox. Nominal arrangements for use of the Port Sanitary Authority Hospital Ship "Mayfly"—which is in bad condition and unseaworthy.

14. BOROUGH OF DORCHESTER (DORSET): population (1911), 9,842; Dr. M. B. Arnold.

Authority concerned: Dorchester Town Council.

Ground of Inquiry: Prevalence of diphtheria; request by certain residents for an inquiry.

Chief Facts reported by Inspector: Diphtheria notifications had increased in 1912 and 1913; the average number of notifications from 1907 to 1911, inclusive, had been 6·2: the number for 1912 was 34 and for 1913 was 88. There was an especially heavy incidence in the months of September, October, and November, 1913, and in this group of cases the scholars of one infant school were disproportionately attacked as compared with the general child population. Of the cases notified in the last six months of 1913 the case mortality was slightly over 10 per cent. The isolation hospital was being enlarged, but increased administrative accommodation is still required. There is no steam disinfecter.

15. EAST WESTMORLAND RURAL DISTRICT (WESTMORLAND). See No. 26.

16. EARBY URBAN DISTRICT (YORKS, W.R.) ; population (1911), 6,032 ; Dr. T. Carnwath.

Authority concerned : Earby Urban District Council.

Ground of Inquiry : Housing conditions.

Chief Facts reported by Inspector : Housing conditions in Earby appear to be fairly satisfactory ; there are a few unsanitary areas—e.g., in and about Island Square, Aspen Lane, Dotcliffe Road, &c.—which require attention ; the work of inspection under section 17 (1) of the Act of 1909 is progressing very slowly and requires to be expedited ; there is need for a proper water supply to the cottages at New Hagne ; it is also desirable that the district council should insist on fresh-water closets in connection with new buildings and proceed as rapidly as is practicable with the conversion of the existing dry and waste water closets. There is room for improvement in the frequency and efficiency of the scavenging, and in this connection the advantages of the movable receptacle are urged.

17. EYE BOROUGH (SUFFOLK) ; population (1911), 2,000 ; Dr. F. Seymour.

Authority concerned : Eye Town Council.

Ground of Inquiry : Medical Officer of Health drew attention to the unsatisfactory condition of the borough when reporting on the occurrence of diphtheria.

Chief Facts reported by Inspector : Considerable amount of antiquated house property, much of which in unsatisfactory condition. Water supply from shallow wells liable to pollution from privies. These form half the closet accommodation in borough ; only 29 w.c.'s known to exist. Open ashpits practically universal ; scavenging not carried out by town council. Hospital accommodation, "Post house," an ancient two-story cottage with neither bath nor closet therein. No means of disinfection.

18. GLOSSOP DALE RURAL DISTRICT (DERBY) ; population (1911), 4,009 ; Dr. T. Carnwath.

Authority concerned : Glossop Dale Rural District Council.

Ground of Inquiry : Local complaints as to shortage of habitable dwellings.

Chief Facts reported by Inspector : Agriculture is the chief industry ; there are some small mills giving employment to about 120 hands. A considerable number of the inhabitants are employed in mills in the adjoining districts. Housing conditions are fairly good ; there are no one-roomed tenements, and only a few two- and three-roomed ; there are comparatively few houses which could be described as "so dangerous, &c., as to be unfit for human habitation" ; the defects are chiefly of the adjuncts—larders, sculleries, closets, &c. ; there is very little over-crowding. On the whole the evidence of scarcity of accommodation is not very strong, though there is no surplus. It is probable that a few more cottages will be required to enable the district council to deal effectively with what insanitary property there is. There is not much building activity in

the district; "no working-class houses have been erected there for many years"; all building land is leased, and the terms are not encouraging to builders.

The only part of the district which is sewered satisfactorily is Marple Bridge. Water supply is in private hands, and there is doubt as to its sufficiency for purposes of closet accommodation. There is no public scavenging in any part of the district.

19. GREAT WAKERING (ESSEX); population (1911), 1,842; Dr. J. R. Hutchinson.

Authority concerned: Rochford Rural District Council.

Ground of Inquiry: Towards the end of the year 1913 the Board had been in correspondence with the rural district council in regard to multiple duties being imposed on the inspector of nuisances which in the Board's opinion he had no time to discharge without detriment to his work as an inspector of nuisances. The medical officer of health had resigned in August, 1913, but he continued to hold office pending the completion of arrangements for the appointment of a whole-time officer in combination with neighbouring districts. On the occurrence of cases of diphtheria towards the end of the year 1913 and in January, 1914, the Board wrote to the district council requesting to be furnished with information as to the circumstances in which these cases had occurred and the measures taken for checking the spread of the disease. No satisfactory reply being received, Dr. Hutchinson was instructed to investigate the circumstances.

Chief Facts reported by Inspector: Eight cases of diphtheria occurred in the village in the last three months of 1913; in the first six weeks of 1914 there were 23 others; 23 out of 33 patients attended the local school. It is not known how the disease was introduced, but there is little doubt that school attendance was responsible for the considerable increase in the number of cases in January and the first half of February. In all, seven children who were harbouring bacilli in their throats were detected. There was no evidence to indicate milk infection, but Hoffmann's bacilli were isolated from the throat of a boy who assisted a dealer in the village in the distribution of milk, and were also isolated from a sound scab on the forearm of a farmer who produced and sold milk locally. True diphtheria bacilli were isolated from a pustule on the cheek of a young man who was ill for a week with a septic focus on the left forearm which closely simulated anthrax and with anomalous febrile symptoms. The septic focus was healed when the swab was taken; during the patient's convalescence his wife and child developed enteric fever. No connection could be made out between this man's illness and the prevailing epidemic. The sanitary condition of the school and village is very unsatisfactory. No drinking water is laid on to the school, and it is served by a huge block of pit privies. The bulk of the sewage of the village finds its way into five large sewer ditches in which it stagnates and becomes very offensive. Some portions of the village are undrained.

20. HAMBLEDON RURAL DISTRICT (SURREY); population (1911), 25,369; Haslemere parish, now an urban district, leaving presumed population of rural district, 21,849; Dr. E. P. Manby.

Authority concerned: Hambledon Rural District Council.

Ground of Inquiry: Statements in medical officer of health's annual reports as to need for houses for the working classes in several parts of the district, and subsequent correspondence between the Board and the rural district council upon the question.

Chief Facts reported by Inspector: General condition of dwellings in the rural district fair structurally, but shortage of houses for the working classes in the parishes of Elstead, Alfold, Hascombe, and St. Martha. Generally throughout the district houses seldom remain empty for long, and rents in some parishes, *e.g.*, Witley, Cranleigh, Chiddingfold, Dunsfold, Blackheath in Wonersh, and Shalford, are unduly high. In remote parts of rural parishes the rents are comparatively low. As a result of high rents there is some sharing of houses by two families, and some overcrowding in parts of the district. Area of the district extensive and inspector of nuisances advanced in years, hence the systematic inspection of dwellings is not proceeding sufficiently rapidly, and nuisances ordered to be abated are not followed up closely enough. A second inspector of nuisances or an assistant inspector should be appointed, who should for a time devote himself largely to inspections under the Housing, Town Planning, &c., Act, 1909.

21. HAYFIELD RURAL DISTRICT (DERBYSHIRE); population (1911), 5,170; Dr. E. P. Manby.

Authority concerned: Hayfield Rural District Council.

Ground of Inquiry: Severe strictures upon the sanitary circumstances and administration of the rural district made by the retiring medical officer of health in his final report. Resentment felt by rural district council, and request made for a public inquiry to be held by the Board.

Chief Facts reported by Inspector: The district was inspected and reported upon in 1886 by the late Dr. Franklin Parsons. Since then many improvements have been made in the sanitary circumstances of the district, *e.g.*, sewerage, sewage works, water supply to part of the district, hospital provision. Public scavenging needed at Hayfield and Mellor. Housing conditions generally not unsatisfactory, but in a few instances defects reported by Dr. Parsons in 1886 still unremedied. Some need for more vigorous and systematic inspection of dwellings under and for the purposes of section 17 (1) of the Housing, Town Planning, &c., Act, 1909. More attention required to the inspection of cowsheds, slaughter-houses, and bakehouses throughout the district. Conversion of privies to waterclosets throughout the district proceeding somewhat slowly and should be hastened. Salary paid to inspector of nuisances inadequate to allow him to incur expenses of the hire of conveyances, hence much time spent in walking from place to place which could more profitably be devoted to sanitary inspections.

22. *HOLME CULTRAM URBAN DISTRICT (CUMBERLAND); population (1901), 4,494; Dr. R. Farrar. [New Series, No. 95, Price 1s.]
Authority concerned: Holme Cultram Urban District Council.
Ground of Inquiry: Sanitary condition of district.
Chief Facts reported by Inspector: Water supplies inadequate in some parts of district, particularly in Abbeytown. Gravitation schemes needed.
 Sewerage of some parts of district unsatisfactory. Isolation hospital not adequate to modern requirements.
 Houses in some urban parts of the district, particularly in West Silloth in need of structural repair to render them fit for habitation. In rural parts of district cottage property is fairly good on the average but in several villages there are cottages in need of repairs and structural alterations. There are some clay-built cottages. Increased and systematic action should be taken under the Housing (Inspection of District) Regulations and special attention should be given to condition of houses in Blitterlees, West Silloth, and Green Row.
23. KENDAL BOROUGH (WESTMORLAND). *See* No. 26.
24. †KENILWORTH URBAN DISTRICT (WARWICKSHIRE); population (1911), 5,776; Dr. E. P. Manby. [New Series, No. 92, Price 1s.]
Authority concerned: Kenilworth Urban District Council.
Ground of Inquiry: Outbreak of enteric fever probably due to contamination of the public water supply.
Chief Facts reported by Inspector: Actual outbreak commenced on November 22nd, 1913, and between then and December 25th 41 cases occurred (4 deaths). Earliest known cases occurred on October 2nd and 25th, and November 10th. In each of these instances the invaded house drains passed to the same sewer. This sewer was blocked on or before November 17th and overflowed into the Finham Brook. Heavy falls of rain during the first week of October and second and third weeks of November which led also to overflow from the sewer passing into the brook. Water supply of the town provided by the Kenilworth Water Company and derived partly from deep wells but largely at this time from a superficial 'adit' adjacent to the Finham Brook—geological formation sandstone. Probability that the water in the adit received specific pollution from the Finham Brook—contaminated as described above—either through the porous sandstone or through an imperfectly closed overflow pipe. Prompt measures taken by the urban district council and the water company to cope with the outbreak when established. Unnecessary delay in obtaining chemical and bacteriological analyses of the suspected water, but practically all cases infected before the water supply was suspected. Coincident outbreak of gastro-enteritis in Kenilworth and neighbouring districts. Many of the cases could not be ascribed to the drinking of polluted water, but the 'explosive' character of the outbreaks in Kenilworth suggested that both the gastro-enteric and enteric infections were water borne.

* Inspection made in 1912-3. † Report reproduced in Appendix A, No. 4.

25. LAMBETH METROPOLITAN BOROUGH. *See* No. 43.

26. LANCASHIRE (NORTH WEST) AND WESTMORLAND; Dr. H. A. Macewen. [New Series, No. 98, price 8d.]

Authorities concerned: Barrow-in-Furness and Kendal Town Councils, Ulverston, East Westmorland and South Westmorland Rural District Councils, and Dalton-in-Furness, Ulverston and Ambleside Urban District Councils.

Ground of Inquiry: Poliomyelitis outbreak.

Chief Facts reported by Inspector: There was a total of 56 cases:—eight in Ulverston Rural District; six in Dalton-in-Furness Urban District; two in Ulverston Urban District and 10 in Westmorland. There were 11 deaths among the 56 cases, giving a fatality of 19.6 per cent. This is higher than in most of the epidemics abroad, though rather lower than in the epidemic reported by Dr. Reece in Devonshire and Cornwall in 1911, where the fatality was 22.1 per cent. The cases in Barrow-in-Furness arranged themselves into four fairly well defined, localised, geographical groups besides a number of isolated cases scattered here and there throughout the town and the facts were consistent with the view that the disease spread from Barrow into the surrounding districts. The circumstances connected with the onset of illness in some of the cases seem to suggest that the disease may possibly have been communicated to a susceptible person by direct contact with a person suffering from the disease or with those who had been in contact with a person so suffering. Against the theory of personal carriage of infection is, however, the fact that there was no single instance of multiple cases in the same house among the whole of the 56 cases investigated. It was noticed that in several of the invaded houses there had been a prevalence of "influenza" in other inmates shortly before the time that the poliomyelitis case occurred, but it is impossible to say whether (a) this was coincidence, (b) the suspected "influenza" was a manifestation of poliomyelitis without any of its characteristic sequelæ, or (c) the recent influenza attack may have conferred some degree of immunity against poliomyelitis in those not affected by the disease.

27. LEWISHAM METROPOLITAN BOROUGH. *See* No. 43.

28. LLANELLY PARISH (BRECKNOCK); population (1911), 3,453; Dr. Morgan Rees.

Authority concerned: Crickhowell Rural District Council.

Ground of Inquiry: Insufficiency of housing accommodation for the working classes. Report of medical officer of health.

Chief Facts reported by Inspector: Inhabitants dependent upon collieries of adjoining districts. Parish of Llanelly forms the watershed of the Clydach. It contains a number of small villages dotted here and there on sides of the valley.

Houses are poor and not one seems to be in good repair. They are devoid of pointing, and caves troughing. They are damp and deficient in light and ventilation. Some are built back to earth.

The rural district council have neglected to deal with insanitary property.

Need for action under Part III. of the Housing of Working Classes Acts 1890 to 1909.

29. LLEYN RURAL DISTRICT (CARNARVONSHIRE); population (1911), 16,839; Dr. Morgan Rees.

Authority concerned: Lleyn Rural District Council.

Ground of Inquiry: Housing conditions of the working classes in the district.

Chief Facts reported by Inspector: Large area of district and poor travelling facilities. 96 per cent. of houses rented at or below £16 per annum. Foundations, damp-proof courses, and eaves-troughing generally absent. Yards unpaved and drainage absent. Windows small and fixed. Houses generally in disrepair, as evidenced by leaking roofs, broken walls and floors. Building by private enterprise at a standstill. Need for action under Part III. of the Housing of the Working Classes Act, 1890.

Water supplies of villages, e.g., Aberdarm and Edeym, and outlying cottages derived from polluted streams and dip-wells.

Absence of sewerage and drainage in the villages. Absence of scavenging. No isolation hospital accommodation. District too large for one inspector of nuisances.

30. BOROUGH OF LUTON (BEDS.); population (1911). 49,978; Dr. M. B. Arnold.

Authority concerned: Luton Town Council.

Ground of Inquiry: Prevalence of diphtheria.

Chief Facts reported by Inspector: The average yearly number of notifications of cases of diphtheria for the five years ending in 1912 had been 46. In the first six months of 1913 there were 21 cases notified. In the second six months of 1913 there were 145 cases notified. The 145 cases occurred in 119 houses and there were 15 deaths. 116 patients were under 15 years of age. The epidemic period began whilst the schools were closed and later cases were distributed in several schools. The great majority of the cases occurred in one quarter of the town. No evidence was obtained of food infection. The isolation hospital was unsatisfactory in several respects.

31. PADIHAM URBAN DISTRICT (LANCASHIRE); population (1911). 13,635; Dr. T. Carnwath. [New Series, No. 101, price 4d.]

Authority concerned: Padiham Urban District Council.

Ground of Inquiry: High infant mortality, housing conditions, local complaints.

Chief Facts reported by Inspector: As regards infant mortality—apart from the bare record of the *causa mortis* as certified by the medical man in attendance there is no exact information available. Among the probable contributory factors are the occupation of the mothers in the mills with consequent neglect and mismanagement of the children, insanitary housing conditions, unsatisfactory methods of excrement disposal and absence of open spaces.

Housing conditions in the older parts of the town are very unsatisfactory; there are many houses which may fairly be described as “unfit for human habitation:” the conditions making for unfitness are those common to old and neglected cottage property. An outstanding defect is the want of open space about the dwellings. There is much overcrowding. Mention is made of 44 houses with

an aggregate of 99 bedrooms occupied by 461 persons, of whom less than one-half were children under 10 years of age. Other evidence is given of the scarcity of houses in Padiham. There has been building but not sufficient to effect any marked improvement as regards overcrowding. Complaint is made of the high price of land, which complaint has led the district council to propose a reduction of the amount of rear space to be required in connection with new buildings.

The general sanitary administration of Padiham calls for little comment. The staff is efficient but not large enough.

32. PENGEDOWN URBAN DISTRICT (KENT). See No. 43.

33. PENMACHNO PARISH (CARNARVONSHIRE); population (1911), 1,560; Dr Morgan Rees.

Authority concerned: Geirionydd Rural District Council.

Ground of Inquiry: Unhealthiness of housing conditions. Local complaints.

Chief Facts reported by Inspector: Depopulation of parish consequent on depression in local slate industry resulting in a large number of empty houses. Chief defect of houses in parish is dampness. Houses situate back-to-earth in the villages of Penmachno, and houses in a dilapidated condition in the village of Cwm-penmachno.

34. POOLE BOROUGH (DORSET); population (1911), 38,885; Dr. J. R. Hutchinson.

Authority concerned:—Poole Town Council.

Ground of Inquiry: To ascertain action taken by town council to carry into effect the recommendations made by Dr. Sweeting after inspection of the district in 1912.

Chief Facts reported by Inspector: Progress has been made in connection with the proposed enlargement of Alderney Hospital for infectious diseases, the making up of private streets, dealing with insanitary houses, provision of sewers, and connection of house drains with sewers. Attention drawn to construction of new cesspools contrary to the council's byelaws. No action so far taken to improve the condition of cowsheds and milkshops. Alterations desirable in the organisation of the medical officer of health's department and in certain arrangements for sanitary administration.

35. RUTHIN RURAL DISTRICT (DENBIGH); population (1911), 9,076; Dr. Morgan Rees.

Authority concerned: Ruthin Rural District Council.

Ground of Inquiry: Annual report for 1913 of the medical officer of health stating the general want of cottages, existence of overcrowding, and the insanitary condition of existing cottages.

Chief Facts reported by Inspector: District sparsely populated. Over 92 per cent. of cottages rented at and below £16. Majority of cottages more or less dilapidated. General absence of foundations and dampproof courses. Windows small and fixed. Many houses built against the earth. Chief defects are dampness, dilapidations, and insufficient light and ventilation. Overcrowding is prevalent. General

demand throughout district by the working classes for cottages. Provision of water supplies to certain parishes is under consideration of rural district council. Cottages in outlying parts dependent upon streams and dip-wells. Closet accommodation chiefly of the pit privy type, the buildings being ruinous. Chief nuisances due to accumulation of house refuse and manure. Absence of scavenging. Registered premises in fair condition.

36. ST. NEOTS RURAL DISTRICT (HUNTINGDON); population (1911). 7,227; Dr. J. R. Hutchinson.

Authority concerned: St. Neots Rural District Council.

Ground of Inquiry: Alleged unsatisfactory housing conditions and suspected inefficiency of the work of the medical officer of health.

Chief Facts reported by Inspector: The district was inspected and a report by the late Dr. Deane Sweeting issued in February, 1907. The inspector formulated a series of 13 recommendations. Five of these were found to have been disregarded, while the degree of compliance with five others is so slight as to be almost negligible. Only on three can it be said that a serious attempt has been made to act. The responsibility for this falls partly on the council and partly on their officers, the former not always acting upon the advice tendered by the latter. In the matter of housing, instances are not wanting in which closing and demolition orders have been disobeyed and the houses continue to be occupied although adequate works of repair have not been executed. There are a large number of occupied "mud and stud" houses, which by reason of general decay, defective thatch, dampness of floors and walls, defective and inadequate windows, bedrooms wholly or partially in the roof, and lack of fireplaces and other adequate means of ventilation, are unfit for human habitation. At Abbotsley, Buckden, Great Staughton, Kimbolton and elsewhere there is a lack of houses for the working classes. Since Dr. Sweeting's report the powers and duties of local authorities have been largely increased by the Housing and Town Planning Act, 1909, and the Housing (Inspection of District) Regulations, 1910, which require systematic inspection of houses to be made, proper records to be kept, and reports made to the district council. On such reports it rests with the district council to take action. Hitherto the St. Neots Rural District Council have taken very insufficient action in this direction.

The precincts of many houses at Kimbolton, Buckden, Catworth, and Great Staughton were found to be very dirty owing to the unpaved condition of backyards, the accumulation of house refuse, and the custom of placing yard gullies a considerable distance from back doors and so raising them as to render it impossible for them to adequately drain the surroundings. The scavenging of Kimbolton is badly done and the pollution of the Kym continues.

The failure of the district council to exercise their powers is in a large measure responsible for the dearth of habitable houses in certain villages. Apart from the question of housing the main need of the district is, as it was in 1906,

organised and systematic inspection by the medical officer of health and the inspector of nuisances, with regular reports and advice to the council, who should take efficient and prompt action on such reports.

37. SEDBERGH RURAL DISTRICT (YORKS., W.R.); population (1911), 3,737; Dr. T. Carnwath.

Authority concerned: Sedbergh Rural District Council.

Ground of Inquiry: Housing conditions.

Chief Facts reported by Inspector: Many old houses, some of which date back to the 17th and 18th centuries: the defects are chiefly of construction and of arrangement on site: there is insufficient or entire absence of provision against damp: many of the rooms are low, badly lighted and badly ventilated: many of the windows are either standsheets or single-pane casements: in Sedbergh, particularly in and about the Main Street, and in parts of Dent, houses are huddled together on sites altogether inadequate to the requirements of a human dwelling. In some cases closet accommodation is unsatisfactory: the water supply of some of the outlying houses and hamlets requires attention.

There is evident scarcity of house accommodation to meet which a building scheme under Part III. of the Act of 1890 is called for. Attention is drawn to the need for a scavenging system in Dent.

38. SETTLE RURAL DISTRICT (YORKS. W.R.); population (1911), 14,901; Dr. T. Carnwath.

Authority concerned: Settle Rural District Council.

Ground of Inquiry: Housing conditions.

Chief Facts reported by Inspector: Housing conditions generally are somewhat above the average. Much good work is being done by the district council in the matter of repairs. Bolder and more comprehensive action is called for, however, and this is urged upon the district council. There are still some houses which are unfit for human habitation and a considerable number requiring attention as regards provision against dampness, improvement of lighting, ventilation, &c. To enable the council to deal freely with unsanitary property there is urgent need for more houses, particularly in Settle, Stainforth, Horton, Ingleton and Bentham. The work of inspection under Section 17 (1) of the Act of 1909 requires to be expedited. Attention is drawn to the need for public scavenging at Bentham, Long Preston, Burton and Hellifield, and for greater oversight of the closet accommodation.

39. SHERBORNE URBAN DISTRICT (DORSET); population (1911), 5,953; Dr. M. B. Arnold.

Authority concerned: Sherborne Urban District Council.

Ground of Inquiry: Prevalence of diphtheria; request for investigation by the Board from the urban district council and others.

Chief Facts reported by Inspector: 20 cases of diphtheria were notified in 1912. An outbreak, beginning in November, 1912, continued during the early part of 1913. In May, 1913, there was a further outbreak, and from May to the end of August 49 cases were notified. The type of the

disease was mild. Infection appeared to have spread mainly by personal contact, but in the last outbreak suspicion fell on milk as a factor in the spread of infection.

The Isolation Hospital, which is used jointly by the Sherborne Urban and Rural Districts, was inadequate and unsatisfactory.

40. SILSDEN URBAN DISTRICT (YORKS., W.R.); population (1911), 4,960; Dr. T. Carnwath.

Authority concerned: Silsden Urban District Council.

Ground of Inquiry: Housing conditions.

Chief Facts reported by Inspector: Majority of the houses substantially built and fairly satisfactory; usual accommodation, four or five rooms. The most prominent defect in the older and more insanitary areas, of which some still remain, is want of open space about the houses; others encountered are dilapidations, dampness, low ceilings, irregular and defective floors, particularly of sculleries and living rooms, want of proper lighting and ventilation, decayed window frames, insanitary and insufficient closet accommodation, and unpaved yards. There is still a large number of back-to-back houses. Of the houses visited, a considerable number might be reasonably regarded as unfit for human habitation, and there are many which will require a great deal in the way of structural alteration and repairs to make them reasonably fit for occupation. It is suggested that the district council should discourage the introduction of waste-water closets, at any rate in connection with new houses.

41. SKIPTON URBAN DISTRICT (YORKS., W.R.); population (1911), 12,977; Dr. T. Carnwath.

Authority concerned: Skipton Urban District Council.

Ground of Inquiry: Housing conditions.

Chief Facts reported by Inspector: Water supply, drainage and general sanitary circumstances call for little comment. As regards housing, Skipton is an old town with a heritage of narrow courts and yards; many of the houses in these courts are small with rooms insufficiently lighted and ventilated, and their cramped position makes it difficult or impossible to secure provision of adequate conveniences. A considerable number of houses are described as unfit for human habitation. There are no cellar dwellings, but back-to-back houses still number 243, and there are in addition 92 houses which, though not back-to-back, have neither through way nor through ventilation. There are some empty houses, but not sufficient to enable the district council to deal adequately with the insanitary areas. Simultaneous action under Parts II. and III. of the Act of 1890 is called for.

42. SKIPTON RURAL DISTRICT (YORKS., W.R.); population (1911), 18,575; Dr. T. Carnwath and Dr. J. R. Prior.

Authority concerned: Skipton Rural District Council.

Ground of Inquiry: Housing conditions.

Chief Facts reported by Inspector: General sanitary circumstances and administration somewhat above the average; room for improvement, however, in many of the dwellings.

There are 221 back-to-back houses, and a large number back-to-earth. Of the houses inspected a considerable number are described as unfit for human habitation. The defects commonly found were dampness, defective ventilation and inadequate closet accommodation; there is some overcrowding; there appear to be very few unoccupied fit houses. As further evidence of the need for more houses in certain of the parishes are mentioned the high rents and the fact that in some cases labourers have to travel long distances to work.

43.* SOUTH LONDON; Dr. H. A. Macewen. [New Series, No. 94. Price 4d.]

Authorities concerned: The Metropolitan Borough Councils of Lambeth, Camberwell, and Lewisham; the Urban District Councils of Beckenham and Penge; and the Town Council of Croydon.

Ground of Inquiry: Epidemic of diphtheria.

Chief Facts reported by Inspector: There were 119 cases and one death. The epidemic commenced on 21st November, and from 25th November to 14th December—a period of 20 days—it continued to attack, on an average, 4·3 new houses per day, the highest number of new houses attacked on any one day being nine. Milk supplied from Dairy “X,” in Lambeth, was the factor common to all the houses affected in the six districts concerned. The epidemic was brought to an end by the pasteurization of all milk sent out from Dairy “X,” on the recommendation of Dr. Priestley, of Lambeth. Dairy “X” received the great bulk of its milk supply from 17 farms in Surrey and Sussex. Dr. Child, Medical Officer of Health of the West Sussex Northern Combined Sanitary District, reported that a milker had been discovered on a Sussex farm suffering from “milker’s finger.” The condition of the finger was such that it had to be amputated, and Dr. Child sent it to the Clinical Research Association for bacteriological examination, with the result that a virulent diphtheria bacillus was isolated, which, on inoculation into a guinea-pig, killed the experimental animal in 48 hours. At this farm two other milkers were found with sores on their hands. From a sore on the hand of one of these milkers a virulent diphtheria bacillus was isolated, while the sores on the hand of the other milker were healed at the time he came under observation. Five of the cows at the farm had irregularly shaped sores situated on the upper half of the teats. These sores were unfortunately healed, and it was impossible to take swabs from them with a view to the discovery of the causative micro-organism. It was quite clear that the Sussex farm was the source of infection, and it was difficult, if not impossible, to dissociate the cows from the milkers in considering how the milk became infected. The milkers could hardly have been infected one after another on the fingers apart from the agency of infection on the cows’ teats which they handled, and the simultaneous presence of sores on the teats shows how this infection may have come about.

44. SOUTH WESTMORLAND RURAL DISTRICT (WESTMORLAND).
See No. 26.

* Report reproduced in Appendix A, No. 5.

45. SUNDERLAND RURAL DISTRICT (DURHAM); population (1911), 29,002; Dr. M. B. Arnold.

Authority concerned: Sunderland Rural District Council.

Ground of Inquiry: Prevalence of scarlet fever: the medical officer of health reported that the type of the disease was of greater severity than in previous years.

Chief Facts reported by Inspector: The case mortality in 933 cases notified from 1905 to 1912, inclusive, was 1.1 per cent.; the highest for any of these years was 3.1 per cent. (in 1910); the case mortality in 440 cases notified from the beginning of 1913 to the end of February, 1914, was 4.5 per cent.; the majority of patients in each group were treated at home. The account given by the medical officer of health of the clinical course of the non-fatal cases seen by him also suggested an increased severity of type.

46. TETBURY URBAN DISTRICT (GLOS.); population (1911), 1,758; Dr. T. Carnwath.

Authority concerned: Tetbury Urban District Council.

Ground of Inquiry: Paucity of information as to housing conditions in the annual reports of the medical officer of health.

Chief Facts reported by Inspector: Tetbury is a small market town with no industries of any account. Many of the working-class houses are in a deplorable condition through age, neglect and faulty construction. A large number may be described as "unfit." Though there is very little overcrowding in the legal sense, the accommodation is in many cases insufficient to allow of proper separation of the sexes. There are only two or three empty houses fit for occupation. The insanitary property cannot be dealt with effectively until more houses are provided. It is doubtful whether an entirely self-supporting scheme can be devised. Scavenging and closet accommodation require attention. More effective action is called for in dealing with slum property; in this connection some change in the personnel of the Housing Committee seems desirable if it is to inspire confidence.

47. TETBURY RURAL DISTRICT (GLOS.); population (1911), 4,286; Dr. T. Carnwath.

Authority concerned: Tetbury Rural District Council.

Ground of Inquiry: Paucity of information as to housing in the annual reports of the medical officer of health.

Chief Facts reported by Inspector: The type of house common in the district is not bad but many of the cottages have been allowed to fall into decay. A number of occupied houses are described as unfit for human habitation, particularly in Cherington, Avening, Newington Bagpath, Long Newton, and Didmarton. The defects enumerated include leaky roofs, dilapidations of walls, ceilings and stairs, decayed floors, inadequate lighting and ventilation, insanitary precincts and want of proper larders, sculleries and closets. There are very few empty houses in all respects reasonably fit. Some of the employees of the district council are housed in very insanitary dwellings. Additional evidence of scarcity of accommodation lies in the fact that a considerable number of the rural labourers are

compelled to live in unwholesome cottages in Tetbury town because there are no houses for them elsewhere. It will be difficult to deal adequately with these conditions unless further housing accommodation is provided. There is no disposition on the part of private enterprise to meet the need. The inspection under section 17(1) of the Act of 1909 should be expedited. The methods of sewage and refuse disposal are makeshift and involve risk to the water supply, which is mainly derived from surface wells.

48. ULVERSTON RURAL DISTRICT (LANCASHIRE). *See* No. 26.

49. ULVERSTON URBAN DISTRICT (LANCASHIRE). *See* No. 26.

50. WELLS URBAN DISTRICT (NORFOLK); population (1911), 2,565;
Dr. S. M. Copeman.

Authority concerned: Wells Urban District Council.

Ground of Inquiry: Complaints from officials and local residents.

Chief Facts reported by Inspector: Sanitary conditions of the town of Wells-next-the-Sea most unsatisfactory in many respects. Water supply derived entirely from surface wells, in some instances within short distance of privies and cesspools, and liable to pollution. Analyses made in 1911 (the last occasion) showed samples to be polluted and unfit for drinking purposes. Wells in lower part of town near quay apt to be invaded by sea water at high tides. Many of the privies and large open ash-pits or middens in filthy condition. Of these, the contents are removed by public scavenger in few instances. Otherwise, disposal of contents left to householders, who usually possess no ground of their own for the purpose. The existing sewerage system only serves limited area, and urgently requires attention; levels in places being defective mainly owing to uncemented pipes having sagged and thus allowing accumulation of silt and putrescible refuse. Many cottages have no house-drains, and no curtilage, so slops and other liquid refuse thrown on ground outside cottages. Dwellings often dark, dirty, damp, ill-ventilated, crowded on area and overcrowded; but great difficulty in dealing with these cases as no other cottages available. Action by Council under Part III. of the Housing of the Working Classes Act, 1890, urgently needed.

51.* WIGTON URBAN DISTRICT (CUMBERLAND); population (1911), 3,687; Dr. R. Farrar. [New Series, No. 95. Price 1s.]

Authority concerned: Wigton Urban District Council.

Ground of Inquiry: Sanitary condition of district with special reference to housing conditions.

Chief Facts reported by Inspector: Gross overcrowding of houses on area; several obstructive buildings which ought to be demolished; many insanitary dwellings, some of these being old weaving-sheds converted into dwellings damp by reason of defective walls, absence of damp-proof course, or absence of cave-spouting, and in some cases

* Inspection made in 1912-3.

excavation of the ground floor to a depth in some cases of more than 2 feet.

Regular inspection of houses is required, and action should be taken under the Housing Acts. It may be necessary that certain areas should be scheduled as unhealthy areas under the Housing of the Working Classes Act, 1890.

Water supply and sewerage satisfactory, but treatment of sewage by irrigation inadequate.

No isolation hospital provision.

- 52.* WIGTON RURAL DISTRICT (CUMBERLAND); population (1911), 11,383; Dr. R. Farrar. [New Series, No. 95. Price 1s.]

Authority concerned: Wigton Rural District Council.

Ground of Inquiry: Sanitary inquiry with special reference to water supplies.

Chief Facts reported by Inspector: Water supplies are good in the southern portions of the district, but the villages on the alluvial area towards the Solway Firth are in urgent need of water. A gravitation scheme for supplying water to those portions of the district which need it was adopted by the district council, but, meeting with considerable local opposition, was dropped and is now in abeyance.

Majority of working classes fairly well housed, but defective and insanitary housing in some parts of the district, particularly in Fletchertown, Bolton New Houses, Blennerhasset, Caldbeck, and Ireby. Progress in respect of housing has been made, but needs to be continued.

Cowsheds in many places defective and overcrowded.

No isolation hospital provision.

53. WIMBORNE MINSTER URBAN DISTRICT (DORSET); population (1911), 3,711; Dr. F. St. George Mivart.

Authority concerned: Wimborne Minster Urban District Council.

Ground of Inquiry: Complaint by medical officer of health that he had had to resign as protest against the refusal of inspector of nuisances to work under his direction, and to carry out on his own property work stated by medical officer of health to be necessary; and that the urban district council had not supported the medical officer of health.

Chief Facts reported by Inspector: Housing conditions on whole not bad. Some want of cottages for poorest working class. A few cottages need repair to put them in proper habitable condition. Many houses with defective guttering, &c. Paving of yards needed in several places. Water supply obtained principally from private wells; there is also a public water supply. The former supply unsatisfactory; wells liable to contamination by soakage from cesspools with which the place seems honeycombed. The public water supply by Wimborne Water Company is now from an artesian well near Walford Bridge. There is also a shallow well said to be disused. The Company's undertaking has now been acquired by the Bournemouth Water Company. No system of sewerage: but sewer pipes laid in sections on

* Inspection made in 1912-3.

sites of old drains, discharging into river. House drains not allowed to be connected with these sewers unless provided with cesspool having overflow to a filter through which house sewage escapes to sewer. Little or no nuisance apparent at outfalls of sewers at time of visit. A large number of private soakaway cesspools—some of large size—some in possession of urban district council.

Excrement disposal generally by closet pails. Methods of emptying and dealing with excreta unsatisfactory. Refuse removal and disposal not very satisfactory. Two large beerhouses used as lodging houses, but owing to the clerk's decision not regarded as common lodging houses. The inspector of nuisances is also surveyor. Action under Housing, Town Planning, &c. Act, 1909, and Housing (Inspection of District) Regulations, 1910, has not been satisfactory. No isolation hospital. A few cases of infectious diseases sent to Blandford Hospital. No disinfecter. Disinfection of dwellings has to be carried out at landlord's expense. Complaint by late medical officer of health against inspector of nuisances not completely justified; evidence of personal squabbles, but inspector of nuisance's refusal to provide guttering ordered by medical officer of health was not justifiable. Need for action under Housing Regulations—provision of sewerage—attention to contaminated wells.

54. WINCANTON RURAL DISTRICT (SOMERSET); population (1911), 16,439; Dr. R. Farrar.

Authority concerned: Wincanton Rural District Council.

Ground of Inquiry: Information needed as to sanitary circumstances of district.

Chief Facts reported by Inspector: Insufficiency of water-supplies in many villages in this district. Sewerage and sewage disposal schemes needed in several villages; many w.c.'s have no flushing cisterns but are hand-flushed. In some parts of the district there is insanitary and dilapidated cottage property. Slaughter-houses not regulated. Insufficient inspection under Dairies, Cowsheds, and Milkshops Order of 1885. Infectious diseases hospital inadequate to the needs of the district. Prevalence of enteric fever (21 cases) at Templecombe and S. Cheriton in November, 1913. The Templecombe cases were almost certainly due to infection of the water supply. Proper water supply and sewerage needed for both these villages.

55. WINSFORD URBAN DISTRICT (CHESHIRE); population (1911), 10,770; Dr. S. M. Copeman.

Authority concerned: Winsford Urban District Council.

Ground of Inquiry: Continued prevalence of diphtheria. Request of medical officer of health for the Board's assistance.

Chief Facts reported by Inspector: The outbreak, for the most part of mild type, had continued over a period of many months with occasional intermissions, nine being the largest number of cases recorded in any one week. Winsford Urban District is made up of two districts, Wharton and Over, separated from one another by the River Weaver. In these districts incidence of the disease on population has

been in the proportion of about four to one. Wharton comprises the more insanitary area of the urban district. Until recently all house refuse was dumped into the roadways, there to await collection by the council's scavenging staff. For this reason, and because watering of roads in dry weather not sufficiently attended to, dust, which on occasion must contain infective material, is blown about in large quantities. Inhalation of this dust likely to account for prevalence of sore throats and probably of diphtheria.

No evidence whatever as to milk or food of any kind having been implicated in spread of the disease. School attendance and presence of possible "carriers" not specially concerned. Considerable proportion of adults affected, but practically no secondary cases in households.

The urban district council are taking energetic steps to improve sanitary conditions, especially as regards storage and collection of house-refuse.

56. WOODBRIDGE RURAL DISTRICT (SUFFOLK); population (1911), 16,314; Dr. W. W. E. Fletcher.

Authority concerned: Woodbridge Rural District Council.

Ground of Inquiry: Outbreak of scarlet fever.

Chief Facts reported by Inspector: See Appendix A., No. 3.

57. BOROUGH OF WORTHING (WEST SUSSEX); population (1911), 30,305; Dr. H. A. Macewen.

Authority concerned: Worthing Town Council.

Ground of Inquiry: Outbreak of diphtheria.

Chief Facts reported by Inspector: The outbreak—which comprised some 52 cases—commenced by the occurrence of two cases of diphtheria in children residing at a dairy farm "X" situated within the borough boundary. They were immediately removed to hospital and the house thoroughly disinfected. As the father of the family and a lodger were milkers at the farm they were instructed to desist from milking until they received further orders from the Health Department. Suspicion was again aroused by the notification of one case of diphtheria on 5th February, five on 6th February, and eight on 7th February. Inquiry proved that the homes of all these cases obtained milk from one or other of two dairies in the town, both of which received milk from farm "X." On visiting the farm it was found by Dr. Wilshaw (medical officer of health) that the above-mentioned lodger was suffering from diphtheria with a characteristic membrane in his throat, and that he had, without the knowledge or consent of the Public Health Department, resumed milking on 2nd February. He was immediately removed to the isolation hospital. The udders and teats of the cows were disinfected with a strong solution of formalin, while arrangements were made for a completely new set of milkers to replace those at the farm. These measures proved effective in checking the outbreak. It is difficult to account for the occurrence of diphtheria at the farm. It may be mentioned, for what it is worth, that three of the cows had crusted sores on the teats and that a swab taken from one of these revealed, on examination at the Lister Institute, the presence of an organism morphologically indistinguishable from the diphtheria bacillus though it was lacking in virulence.

58. WORTLEY RURAL DISTRICT (YORKS, W.R.); population (1911), 32,803; Dr. W. W. E. Fletcher.

Authority concerned: Wortley Rural District Council.

Ground of Inquiry: Allegations of neglect of duty and of improper action on the part of the inspector of nuisances and surveyor.

Chief Facts reported by Inspector: Public water service, except for outlying houses, almost universal, but in times of drought there is shortage at Luxley, and High Bradfield and Upper Grenoside are badly supplied.

Sewerage for larger centres of population, *e.g.*, at Ecclesfield, Shire Green, Grenoside, Chapeltown, Wadsley Bridge, part of Wadsley, Oughtibridge, Hesley Lane, Worrall, Pilley, and Wortley. Three sewage outfall works—Ecclesfield Village, Chapeltown, and Pilley with Wharnccliffe Colliery Houses. Sewerage from Worrall, Grenoside, Wadsley Lane, Wadsley and Oughtibridge passes to Sheffield sewers, and from Hesley Lane to Rotherham sewers. Sewerage for Charlton Brook and Wharnccliffe Side needs improvement, and provision is needed at Loxley.

Many houses provided with w.e.'s and flushing cisterns, but the majority provided with privy middens, privy ashpits, or pail-closets. Conversion to w.e.'s urgently needed in places, and being gradually effected.

Except for outlying houses public scavenging is in force throughout the district.

In the older villages, and scattered about the district, dwellings of an unsatisfactory character may be found, but these are being improved. Generally the housing conditions are by no means bad.

Slaughter-houses number eighteen. Generally they are clean and well-kept, but some could be much improved in structure.

There are approximately 225 cowkeepers and purveyors of milk. At dairy farms there is plenty of opportunity for improvements in structure, and in the conditions as to cleanliness.

There is a well-built isolation hospital, nominally for 33 beds in six wards, of which two are single-bed wards. On the basis of 2,000 cubic feet per bed it might afford accommodation for 14 beds and 4 cots. It comprises porter's lodge, administrative block, one ward block, with laundry, mortuary, and disinfecting block. There is no accommodation for small-pox, but a site has been secured, plans have been approved by the Board, and the council has some funds in hand, £1,500 having been paid by Sheffield Corporation as compensation for council's loss of interest in Leppings Bridge Small-Pox Hospital.

Nothing was found to justify the persistent attacks on the inspector of nuisances by certain members of the council, one of whom had been prosecuted by him, but since inspection he has resigned both his offices in consequence of renewed attacks; the district has been divided, and two inspectors of nuisances have been appointed, each to one of the divisions.

APPENDIX A., NO. 12.

REPORT by DR. A. W. J. MACFADDEN on the WORK of
INSPECTORS of FOODS during the YEAR 1913-14.

The report now submitted on the work of the Inspectors of Foods is arranged under the following headings:—

1. Work in special relation to the Public Health (Regulations as to Food) Act, 1907.
 2. Local arrangements for food inspection.
 3. Bacterial food poisoning.
 4. Work in relation to the Sale of Food and Drugs Acts.
- Addenda : Circulars 1913 and 1914.

1. WORK IN SPECIAL RELATION TO THE PUBLIC HEALTH
(REGULATIONS AS TO FOOD) ACT, 1907.*Unsound Food and Foreign Meat Regulations.*

Inspections have been made during the year at the majority of the food importing ports in England and Wales in connection with the administration of the Public Health (Foreign Meat) and the Public Health (Unsound Food) Regulations, 1908.

New "Official Certificates."—In accordance with the provisions of Article I. (h) of the Public Health (Foreign Meat) Amending Regulations, 1907, the Board have, on receiving the necessary assurances from the governments concerned, notified their acceptance of a label and brand mark as "official certificates" in respect of pork and other edible portions of the pig which have been inspected in Sweden, and of four labels* in respect of similar products inspected in the four Russian slaughterhouses situated at Libau, Kurgan (2) and Rtistehewo.

Boneless meat.—Improvement in the quality and the packing of boneless meat continues to be maintained. In order to assist importers in the choice of cuts and methods of packing for the purpose of facilitating the admission of such meats into Liverpool, a useful table has been drawn up by the medical officer of health of the Port of Liverpool for the guidance of those engaged in this class of trade. The table shows clearly the cuts which would be admissible under the Foreign Meat Regulations and the methods of packing which should be employed before freezing in order to allow adequate examination of each piece without the necessity of first thawing out.

Argentine tongues.—At the end of July last information was received from Liverpool that numerous tongues arriving there from Argentina were found to be affected with tuberculous and actinomycosis. The information was at once communicated to the medical officers of health of those ports which were likely to receive these tongues. A preliminary examination of the tongues in cold store in London showed the necessity for making detailed examination of entire consignments, and as a result between 1st August and 28th October, 85,445 tongues were examined in the City and Port of London, of which 4,949 or 5·8 per cent. were found to be affected

* Addendum B., p. 113.

with actinomycosis, chiefly in the glands. Careful examination showed that these tongues had been incised and passed for export in Argentina, but it was obvious that in many instances the incisions had not been made in a manner likely to expose the lymphatic glands. In some cases the incisions had exposed the gland, but had not opened it; in others the incised gland showed evidence of disease, but this had not resulted in the rejection of the tongue; while in a number of cases the glands had been removed.

The thawing out and detailed examination of these tongues involved a large amount of extra work on the food inspection staffs of the City of London and the Ports of Liverpool and London, the principal places of entry.

The attention of the Argentine authorities was called to the matter, and steps were taken by them, which have resulted in considerable improvement in the condition of consignments of tongues from Argentina arriving in this country.

Treatment of refrigerated meat by formaldehyde.—Inspectors of foods have taken samples from time to time from cargoes of refrigerated meat treated by the formaldehyde process. On the whole the amounts of formaldehyde found in these samples were not such as would call for action on public health grounds.

Onchocerciasis in Australian beef.—Consignments of beef received from Australia during the past year have shown evidence of the measures which have been taken in Australia to prevent the export to this country of beef affected with onchocerciasis. Occasional consignments are, however, still met with which appear to have received insufficient inspection before exportation. Thus, in a consignment of 1,506 hind quarters examined by the City of London inspectors in November last onchocerciasis nodules were found in 5.4 per cent. of the quarters, and certain consignments of "crops" at Liverpool and elsewhere have been found improperly cut, having had insufficient portions of the brisket removed when judged by the standard laid down by the Commonwealth Government for the guidance of their inspectors. At this latter port early this year a consignment of boneless "plates" was found on examination to contain over 3 per cent. of affected pieces. These "plates" are pieces of meat about 36 inches long and about 12 inches broad cut from the flank and brisket of the fore-quarter. The remainder of the fore-quarter is known as the "crop." The plates have occasionally been found narrower than the standard laid down by the Commonwealth authorities, the object of the exporters apparently being to leave as much meat on the "crop" as possible, in which position it would fetch a higher price.

Difficultly arose during the year over some consignments of cows' udders received from Canada marked "inedible, unfit for food." From inquiries made it appeared that there was a regulation in force in the Dominion forbidding the use of certain parts of the carcase, including the udder, in meat food products. When submitted for inspection with a view to export, therefore, the udders in question could not be marked with the inspection legend and so were marked with the alternative "inedible." This marking in no way implied that the udders were diseased, unsound or unwholesome. Arrangements were made whereby udders taken from carcasses passed for food could, if found satisfactory after special examination, be marked with the inspection legend and exported in packages plainly and legibly marked "Udders, for export."

South African pig carcasses.—When at Southampton Dr. Low was informed that at the end of 1912 a trial consignment of 170 frozen

pig carcasses had arrived from Natal. On being thawed out and examined 23 carcasses were found to be tuberculous and two contained abscesses. A notice for exportation of these carcasses was served on the importers, at whose request the condemned carcasses, about $1\frac{1}{2}$ tons in weight, were destroyed.

French pig legs.—Towards the end of 1913 information was received that a small consignment of pigs legs from France had been imported through Newhaven. No application has been made to the Board for recognition of an official certificate in the case of France and in the absence of such a certificate, imports of this nature are inadmissible from that country. The consignment arrived labelled as suet. A further consignment was subsequently discovered, mixed in baskets with calves heads, &c. The pigs legs, weighing $5\frac{3}{4}$ cwts., were ordered to be re-exported.

Arsenic in sugar.—During the unloading of a cargo of sugar which arrived in the port of London from Pern in March last, it was noticed that some of the bags containing the sugar were covered with borax which had been carried in the same hold and had become loose during the voyage. Samples of this powder were taken and analysis showed them to contain considerable amounts of arsenic. In view of the possible contamination of the sugar arrangements were made for proper re-bagging of the contents of those sacks on which the powder was found. Consignments of the sugar which had already been sent to certain other districts were returned to the London port district for suitable treatment under supervision of officers of the port sanitary authority.

Arsenic and copper on apples.—During the early part of the present year attention was called to the arrival in this country of apples from the United States of America having on their skins a bluish deposit, evidently the remains of an insecticide wash. Analysis showed that copper in small amounts and arsenic in traces were present in this deposit, and in view of this fact the United States Government were informed through the Foreign Office that the Board regarded it as desirable that fruit which had been sprayed by washes containing poisonous materials should, before being exported from the United States, have any deposits left by the wash removed from the skins. The Foreign Office have received a reply from which it appears that the United States authorities are disposed to regard the amounts of insecticide remaining on apples which have been sprayed as negligible from the point of view of public health. Future consignments of apples showing evidence of having been sprayed should be kept under observation.

Complaints as to the administration of the Regulations are very few. One was received early in 1913 through the Colonial Office from the Dominica Fruit Growers Association as to the delay and expense involved in sorting and re-packing certain fruit arriving at Southampton from the West Indies. In one case it was alleged that the delay had caused the fruit to become unsound. Investigation showed that the complaint was groundless. The consignment on sorting at Southampton was found to contain about 30 per cent. of decomposed fruit, and that the records of the ship carrying the goods showed that the fruit when received on board at Trinidad had been over ripe and in many cases mildewed.

Imported Milk and Cream.

Milk production in France.—in view of the importation of milk into this country which has taken place during times of shortage here, Dr. Hancock visited the neighbourhood of Cherbourg in April,

1913, and inquired into the methods of production of milk and cream in the districts concerned in the exportation of these products to England. At the time of Dr. Hancock's visit no State enactment existed respecting the sanitary control of dairies and cowsheds. In several departments, however, prefectorial or municipal orders have been made dealing with the matter, but even these are not obligatory in all cases. There is no legal standard fixed by the State as regards fat and non-fatty solids in milk, but the Prefect of a Department, or the Mayor of a Commune, may by Order fix such standards, and in some cases this has been done. Generally speaking, the character of a milk is determined by its composition compared with the average quality of the milk supplied in the district. This appears to be the method in La Manche, whence milk imported into England is derived.

Imports of fresh milk during the year were insignificant in amount and no samples were taken for bacteriological examination.

Examination of imported cream.—During the summer of 1913 51 samples were taken by inspectors of foods from consignments of cream received in this country from France, and were examined bacteriologically. All except two appeared to have been pasteurised before shipment, and these two showed the highest bacterial content of the series. Boric acid was present in 30 samples, and many of these had higher bacterial contents than others in the series which did not contain this preservative. Eleven samples contained hydrogen peroxide ranging from 0·002 to 0·0005 per cent. and these showed a uniformly low bacterial content. None of the samples was found to contain tubercle bacilli.

Milk and Cream Regulations.

When visiting districts on other subjects inspectors of foods have taken the opportunity of inquiring into the administration of these Regulations, and where necessary have given advice on the subject to the officers concerned. Several points have arisen in connexion with the administration of the Regulations which the Board have dealt with in a circular letter* addressed to local authorities.

Attention was drawn in the last annual report to attempts being made by certain preservative makers to induce manufacturers of and dealers in food products, especially those engaged in the milk, cream, butter and margarine trades, to use preservatives which are likely to escape detection unless specially looked for. Advertisements were issued containing statements that these preservatives were absolutely harmless, although analysis in the Board's laboratory showed that the active agent in them was potassium or sodium fluoride, in one case mixed with sodium benzoate. The Board are in possession of information which shows that similar attempts are still being made, in spite of the fact that the use of such products in milk and cream is specifically prohibited by the Public Health (Milk and Cream) Regulations. One firm of preservative manufacturers has recently been offering a "Special Milk Preservative" which they state to be free from boric acid, and to be very difficult for the analyst to trace. A sample of this preservative was analysed in the Board's laboratory and was found to contain 69·5 per cent. of sodium benzoate and 28·1 per cent. of sodium carbonate.

Towards the end of last year a conviction was secured at the Marylebone Police Court against a dairyman a sample of whose milk on analysis was found to contain four-fifths of a grain of benzoic acid per pint. A fine of £10 and costs was imposed.

* Addendum A., p. 111.

2. LOCAL ARRANGEMENTS FOR FOOD INSPECTION.

Inquiries have been made during the year in a number of districts as to the arrangements made by the local authority for the inspection of foodstuffs in their district, special regard being paid to the inspection of meat.

It has been observed in districts in which meat inspection is established on a good basis that there is a growing tendency on the part of butchers to notify the local authority at once of meat in their possession which is diseased or of doubtful character. Stimulus to such notification is supplied in some districts where the local butchers compensation fund makes it a rule that if diseased meat is seized which has not been reported the butcher does not receive compensation for the value of the meat condemned. In addition, he is, of course, liable to prosecution by the local authority. It is found by experience that knowledge is soon gained of the butchers who can be depended upon to notify the presence of diseased meat and of those who cannot be so trusted. Arrangements of this kind are found to simplify considerably the work of meat inspection.

Supervision of places where food is prepared.—Inspectors have found that in many districts visited more attention is being paid to the condition of premises where food is prepared. In some cases medical officers of health have complained of their lack of powers to deal with such matters, and have suggested that the Board should make Regulation enabling adequate supervision to be maintained over all premises where food is prepared. Although improvement has been effected in many cases, the condition of some of these places is dirty in the extreme, and a danger to persons eating food prepared there. As an example, when visiting West Hartlepool Dr. Low found a room used by a pork butcher for food preparing purposes to be dark and dirty and to be used habitually for gut scraping which was done late at night in order that the nuisance might not disturb the neighbours. Outside the room in the yard was a barrel of unscraped guts in an offensive state, while inside on the filthy floor of the food preparing room were some boned pigs' heads which were being pressed into shape in tins by means of stones which when not in use were kept on the floor of the food preparing room or in the yard, where they would be liable to serious contamination. Conditions such as these are among those which are known to give rise to epidemics of food poisoning.

In the Annual Report for 1909-10 mention was made of the unsatisfactory state of affairs which existed in Sunderland in regard to the sanitary state and situation of the majority of the private slaughterhouses in the town. Dr. Low re-visited the district in September last and found that great improvement had taken place in regard to these matters. Among other things, slaughterhouse byelaws had been put in force, and the number of slaughterhouses had been reduced to 65, all of which were licensed. Structural alterations had been made in many of the slaughterhouses, most of which were well kept. Food is no longer prepared in slaughterhouses and the practice of gutscraping there has been discontinued.

Inspection of food for export.

Inspectors of foods have, during the year, visited the premises of most of the firms exporting meat food products to the United States and Philippine Islands under the system of certification laid down in the Board's memorandum on the subject, and have conferred with the certifying officers as to the arrangements made for carrying out

the requirements of the memorandum. Generally speaking, these arrangements have been found satisfactory and only in two cases have certifying officers found it necessary to refuse certificates on account of irregularities.

3. BACTERIAL FOOD POISONING.

In the autumn of 1913 the Board issued a report by Dr. W. G. Savage on the subject of bacterial food poisoning and food infections (Food Reports, No. 18), which comprised a conspectus of food poisoning occurrences in this country and abroad. In the report Dr. Savage examines closely the various sources from which infection of food materials may take place and indicates the need which exists for further knowledge on this point. In the absence of such knowledge important gaps may exist in the preventive measures employed. Each well investigated outbreak tends to throw some fresh light on the etiology of bacterial food poisoning, and it is therefore of importance that inquiry into every occurrence of the kind, however small, should be taken up and pursued at the earliest possible moment. The Board issued a Memorandum on 12th September, 1911, drawing attention to the need for investigation of these cases and pointing out that an early notification to them by medical officers of health of the occurrence of cases of food poisoning in their districts would enable inspectors of the Board to co-operate with the officers of the local authority in investigation of the outbreak where such co-operation would seem desirable.

During the year under review several minor outbreaks of food poisoning occurred which came to the notice of the Board only through references in the press.

The only outbreak of large dimensions in the country during the year was that which occurred at Newcastle-upon-Tyne in October and November last. The number of persons affected was 523, their illness being characterised by severe gastro-intestinal disturbance and collapse. There were no deaths in this epidemic. As the case is a somewhat unusual one the following particulars may be recorded.

All the persons affected had partaken of milk coming from a farm in the neighbourhood of Newcastle, where, on investigation, it was found that five persons were also ill. It was discovered that a batch of five cows, calved about 18th October, had been purchased at a local auction on 24th October. Their milk had been mixed with that of the other 26 cows in the herd. On 30th October it was noticed that one of the recently calved cows was not well and although she got rapidly worse and her milk yield diminished to one pint, the small quantity obtained from her was daily mixed with the yield of the whole herd. Early on November 1st the cow was found dead in her stall. A bacteriological examination of stools of seven persons affected and of portions of certain organs of the cow showed the presence of an organism of the Gaertner group. It was thought that the cow had become infected with a Gaertner septicaemia following parturition. The unusual completeness of the etiological chain of evidence in this outbreak is due to the promptness with which its investigation was undertaken. A detailed account of the occurrence will be found in a paper read by Dr. Kerr, Medical Officer of Health of Newcastle-upon-Tyne, before the Epidemiological branch of the Royal Society of Medicine and published in the Society's transactions.

4. WORK IN RELATION TO THE SALE OF FOOD AND DRUGS ACTS.

During the year inspectors of foods have visited a number of districts and inquired into the arrangements made for the administration of the Sale of Food and Drugs Acts. In many cases they have been able by conference with the officers concerned to make suggestions with a view to increasing the efficiency of the work done under these Acts.

In previous reports the question of the administration of the Acts by the police has been discussed, and in certain districts visited during the year inspectors have found added proof of the disadvantages attaching to this method of administration.

At Barrow-in-Furness the work under the Acts was, until recently, in the hands of the Chief Constable acting under the Watch Committee. Dr. Hamill visited the district again at the end of last year, and the Council subsequently transferred the administration of the Acts to the Medical Officer of Health and his staff. This change should result in increased efficiency of the work.

In the County of East Suffolk Dr. Litteljohn found that the administration of the Acts by the police was not satisfactory, the methods adopted being of little use for the purpose of detecting modern fraudulent practices. As in several other counties the number of samples taken was quite inadequate.

In several districts visited (including the Counties of East Suffolk and East Sussex) the records of work done under the Acts were kept in an unsatisfactory manner. In some cases the only notes kept were in pocket books, which were liable to be destroyed after a short time.

In many districts visited inspectors of foods have reported a lack of co-operation between the officers concerned in the administration of the Acts. The sampling officer appears often to be alone responsible for the selection of articles to be sampled and for the methods employed, while the medical officer of health appears to take no part in the work. It is apparent that in such cases the utility of the Acts is much impaired, and that improvement in their administration would be effected by frequent conferences between the medical officer of health, the analyst and the sampling officer. In districts where sampling is done by the police or by weights and measures inspectors, the medical officer of health is usually willing to give advice in the matter, although the working of the Acts does not fall within his department.

A Select Committee was appointed by the House of Commons in 1912 to consider and inquire into the question of the sale of Patent and Proprietary Medicines and medical preparations and appliances, and advertisements relating thereto, and to report what amendments, if any, in the Law were necessary or desirable. The Committee continued its sittings in 1913 and I gave evidence before it in June of that year.

ADDENDUM A.—CIRCULAR 1913.

*Circular, Milk and Cream (No. 2).
Counties and Boroughs.
(Sale of Food and Drugs Acts Authorities).*

REGULATIONS UNDER THE PUBLIC HEALTH (REGULATIONS AS TO FOOD) ACT, 1907.

LOCAL GOVERNMENT BOARD,
WHITEHALL, S.W.,
27th October, 1913.

SIR,

I AM directed by the Local Government Board to state that they have had under consideration the question of the manner in which the details of action taken under the Public Health (Milk and Cream) Regulations, 1912, can be most conveniently reported.

It will be remembered that by these Regulations a definite restriction has been placed on the use of preservatives by producers, retailers and others concerned in the milk and cream trade ; no preservative is to be added to milk in any case, and no preservative is to be added to cream which is sold as cream. The Regulations, however, do not prohibit the sale of cream containing borie acid, borax, or a mixture of these preservative substances, or hydrogen peroxide, provided :—

- (1) That it is sold, not as cream, but as preserved cream, and
- (2) That the vessel in which it is sold bears a declaration, in the prescribed form, showing the amount and nature of the particular preservative added.

The addition to cream of any other preservative substances than those mentioned is prohibited.

The object of the Regulations in regard to cream is to secure that preserved cream sold in compliance with the Regulations shall be distinguished at all stages of sale from cream to which no preservative has been added ; this distinction is important in the interests of the public generally, and particularly in the interests of infants and invalids.

In their circular letter of the 6th August, 1912, the Board suggested that the medical officer of health should be instructed to exercise general supervision over the action taken in pursuance of the Regulations, and that the medical officer of health, the officer who directs sampling under the Sale of Food and Drugs Acts, and the analyst, should confer as to the details of the procedure necessary to secure observance of the Regulations.

In amplification of that circular, I am to state that the Board consider that the council should look to their medical officer of health for reports on the administration of the Regulations. For the present it will suffice if a brief statement on the subject is included in the annual report of this officer.

In order to secure completeness and uniformity in this statement, and with a view to saving unnecessary correspondence, the Board think that there would be advantage if the statement were drawn up under the headings shown in the Appendix below, and they would be glad if, for purposes of tabulation, a copy could be forwarded to the Board shortly after the close of the year. If the information necessary for the preparation of this statement is not in the possession of the medical officer of health, the Board will be obliged if the council will give directions for him to be supplied with it.

It will no doubt generally be convenient that analyses which are made for the purpose of these Regulations should be made by the public analyst ; and the Board recommend that this course should be adopted, special arrangements for this work being made where necessary. In any case it is essential that the medical officer of health should obtain information as to the results of the analysis.

The Board understand that it is now customary for public analysts in their reports on samples of milk submitted to them under the Sale of Food and Drugs Acts to state the result of examinations made to detect the presence of preservatives. Where this is done, the analyst's certificate will bring to notice cases where preservatives have been added to milk and the council can then take the action in the matter which the Regulations require.

In the case of cream and preserved cream the analyst who receives a sample taken with a view to checking the observance of the Regulations should be informed precisely of the reason for which it has been taken, and the particular fact or facts which it is desired to ascertain by analysis. On one occasion, for example, the only analytical determination required may be the proportion of milk fat in cream ; on

another, whether a preservative is present ; or on a third, whether the statement on the label as to the nature and amount of added preservative is borne out by analysis. By adjustment of procedure in this way, and by consultations between the medical officer of health and the analyst, it is anticipated that much unnecessary analytical work can be avoided.

The Board would take this opportunity to remind the council that it is the duty of the local authorities specified in the Regulations to see that they are enforced by the administrative procedure authorised under the Regulations, and, should necessity arise, by the institution of proceedings under the public health enactments referred to in the note appended to the Regulations.

For administrative convenience the local authorities specified are those which also administer the Sale of Food and Drugs Acts, and the provisions of the Sale of Food and Drugs Act, 1875, relating to the taking of samples, have been applied to samples taken for the purpose of the Regulations. But the action taken under the Regulations is in other respects independent of the Sale of Food and Drugs Acts and does not affect the action which may be taken under those Acts.

While therefore it may be open to the council on consideration of the report of a public analyst on a sample of milk or cream to take action either under the Sale of Food and Drugs Acts, or under the Regulations, the Board consider that it is generally desirable that in cases in which it appears that the Regulations have been infringed such action as may be necessary should be taken under the Regulations rather than under the Sale of Food and Drugs Acts.

I am to request that the council will take this circular into consideration with a view to making further arrangements, if any are necessary, so that the administration of these Regulations may be carried out and reported upon on the lines above indicated.

I am to add that, as stated in their circular of the 6th August, 1912, the Board are anxious to secure uniformity in the administration of the Regulations, and if difficulties are actually experienced by local authorities in the matter, the Board will be glad to be informed of the nature of the difficulties.

Copies of this circular are enclosed for transmission to the medical officer of health and public analyst. It will be placed on sale, so that additional copies may shortly be obtained, either directly or through any bookseller, from Messrs. Wyman & Sons, Ltd., Fetter Lane, London, E.C.

I am, Sir,

Your obedient Servant,

H. C. MONRO,

Secretary.

APPENDIX.

HEADINGS OF REPORT OF ADMINISTRATION IN CONNECTION WITH THE PUBLIC HEALTH (MILK AND CREAM) REGULATIONS, 1912.

Report for the year ended 31st December, 19 .

1. *Milk ; and Cream not sold as Preserved Cream.*

	(a) Number of samples examined for the presence of a preservative.	(b) Number in which a preservative was reported to be present.
Milk Cream		

Nature of preservative in each case in column (b) and action taken under the Regulations in regard to it.

2. *Cream sold as Preserved Cream.*

(a) Instances in which samples have been submitted for analysis to ascertain if the statements on the label as to preservatives were correct.

(i) Correct statements made	...	...	...	...	...
(ii) Statements incorrect...	...	...	...	...	...

Total
-------	-----	-----	-----	-----	-----

(b) Determinations made of milk fat in cream sold as preserved cream.

(i) Above 35 per cent.	...	...	...	...	...
(ii) Below 35 per cent.	...	...	...	...	...

Total
-------	-----	-----	-----	-----	-----

(c) Instances where (apart from analysis) the requirements as to labelling or declaration of preserved cream in Article V (1) and the proviso in Article V (2) of the Regulations have not been observed.

(d) Particulars of each case in which the Regulations have not been complied with, and action taken.

3. *Thickening substances.* Any evidence of their addition to cream or to preserved cream. Action taken where found.4. *Other observations, if any.*

ADDENDUM B.—CIRCULAR 1914.

*Circular, Foreign Meat (No. 9).**Port Sanitary Authorities.**Certain Sanitary Authorities.*

REGULATIONS UNDER THE PUBLIC HEALTH (REGULATIONS AS TO FOOD) ACT, 1907.

LOCAL GOVERNMENT BOARD,
WHITEHALL, S.W.

13th March, 1914.

SIR,

I AM directed by the Local Government Board to advert to Article I. (h) of the Public Health (Foreign Meat) Amending Regulations, 1909, and to their circular of the 26th January, 1909; and I am to state that, on consideration of communications received through the Foreign Office from the Imperial Russian Government, the Board have caused to be published in the *London Gazette* of the 24th February, 1914, a Notice containing in the schedule descriptions of four labels each of which is declared to be admissible as an "Official Certificate" in respect of pork and other edible portions of the pig which have been subjected to inspection in the particular Russian slaughterhouse mentioned in the label. A copy of this Notice, including the schedule thereto, is appended to this circular.

It should be noted that, for the present, official certification of Russian pork is restricted to meat derived from the four slaughterhouses specified in the Gazette, which are as follows:—

- (1.) No. 1 Slaughterhouse at Libau.
- (2.) Exportation Slaughterhouse, Barselman Society at Station Rtistchewo of Riasan-Oural railway.
- (3.) "Union" Slaughterhouse at Kurgan.
- (4.) Kurgan Export Bacon Factory at Kurgan.

Copies of Circular.

An additional copy of this circular is enclosed for transmission to the medical officer of health. The circular will be placed on sale, so that copies may shortly be obtained, either directly or through any bookseller, from Messrs. Wyman and Sons, Limited, Fetter Lane, London, E.C.

I am, Sir,

Your obedient Servant,

F. J. WILLIS,
Assistant Secretary.

The Clerk to the Port Sanitary Authority,

or

The Town Clerk

or

The Clerk to the District Council.

APPENDIX

Notice inserted in the LONDON GAZETTE of 24th February, 1914.

THE PUBLIC HEALTH (FOREIGN MEAT)
AMENDING REGULATIONS, 1909.

WE, THE LOCAL GOVERNMENT BOARD, in pursuance of the Public Health (Foreign Meat) Amending Regulations, 1909, HEREBY GIVE NOTICE that, for the purposes of those Regulations, the Official Certificates of which the details are set forth in the Representations or designs in the Schedule appended to and forming part of this Notice are, subject to the instructions given therein, hereby declared to be admissible, in the case of the four Russian slaughterhouses specified in the Schedule, from the date of the publication of this Notice, in the manner, to the extent, and subject to the rules and conditions prescribed in this Notice, as evidence that the pig from which any foreign meat has been derived has been certified by a competent authority in the place of origin to be free from disease at the time of slaughter, and that the meat has been certified by the like authority to have been dressed or prepared, and packed with the needful observance of all requirements for preventing danger to public health from using the meat as an article of food :

AND FURTHER, with respect to the manner, to the extent, and to the rules and conditions in, to, and subject to which every official certificate is admissible as evidence for any such purpose as is hereinbefore described, We hereby prescribe as follows, that is to say :—

(i.) An Official Certificate, used in relation to foreign meat, or in relation to a box, case, receptacle or package containing foreign meat shall be admissible as aforesaid only where the meat is derived from a pig.

(ii.) An Official Certificate in the form of a label shall be admissible as aforesaid only where the label is securely affixed or attached to any foreign meat, or to any box, case, receptacle or package containing foreign meat; and where the label so affixed or attached has not, in any other circumstances, or on any other occasion been used as an official certificate.

(iii.) In this Notice, any word or expression to which a special meaning is assigned by the Public Health (Foreign Meat) Amending Regulations, 1909, has the same meaning as in those Regulations.

SCHEDULE.

RUSSIA.

Town	...	...	...	Libau.
Slaughterhouse	...	...	...	No. 1.

A Certificate in the form of a brown label having on it the subjoined representation or design.

In the blank spaces will appear respectively the date of the certificate and the signature of the Government Veterinary Surgeon at the Slaughterhouse.

[Copy of label here inserted.]*

RUSSIA.

Station	...	...	Rtistchewo of Riasan-Onral Railway.
Slaughterhouse	...	...	Exportation Slaughterhouse Barselman Society.

A Certificate in the form of a label having on it the subjoined representation or design.

In the blank spaces will appear respectively the date of the certificate and the signature of the Government Veterinary Surgeon at the Slaughterhouse.

[Copy of label here inserted.]*

* Not here reproduced.

RUSSIA.

Town or Village	...	...	Kurgan.
Slaughterhouse	...	...	"Union."

A Certificate in the form of a label having on it the subjoined representation or design.

In the blank spaces will appear respectively the date of the certificate and the signature of the Government Veterinary Surgeon at the Slaughterhouse.

[*Copy of label here inserted.**]

RUSSIA.

Town or Village	...	...	Kurgan.
Slaughterhouse	...	...	Kurgan Export Bacon Factory.

A Certificate in the form of a label having on it the subjoined representation or design.

In the blank spaces will appear respectively the date of the certificate and the signature of the Government Veterinary Surgeon at the Slaughterhouse.

[*Copy of label here inserted.**]

Given under the Seal of Office of the Local Government Board, this twentieth day of February, in the year One thousand nine hundred and fourteen.

(L.S.)

HERBERT SAMUEL,
President.

F. J. WILLIS,
Assistant Secretary.

* Not here reproduced.

APPENDIX A., NO. 13.

REPORT on the OPERATIONS of the GOVERNMENT LYMPH ESTABLISHMENT, 1913-14; by DR. F. R. BLAXALL.

The amount of glycerinated lymph despatched from the Government Lymph Establishment to the Public Vaccinators of England and Wales during the year ended March 31st, 1914, was 366,716 capillary tubes, each containing sufficient lymph for the vaccination of one case.

Particulars of this despatch are given in Table I.

The results of the use of the lymph during the year for the 318,766 cases of which report has been received show 99·3 per cent. case success, and 95·9 per cent. insertion success.

The primary vaccinations numbered 307,685, giving a case success of 99·4 per cent., and an insertion success of 96·0 per cent.

The re-vaccinations numbered 11,081, giving a case success of 97·8 per cent., and an insertion success of 94·5 per cent.

Table II. shows the results for the whole year, arranged in quarterly periods.

The lymph produced during the year was derived from the vaccination of 322 calves.

All these animals, after slaughter, were examined by our veterinary surgeon and certified to be healthy. Two other calves, which appeared to be in health during the course of vaccination, were found at the autopsy to exhibit tubercular lesions. None of the lymph from these calves was issued.

The bacteriological examinations of the lymph have been carried out as heretofore.

In addition, lymph has been supplied for the use of the Royal Navy sufficient for 26,630 cases, for the use of the Army sufficient for 55,507 cases, for use in the Isle of Man sufficient for 449 cases and to the Local Government Board for Scotland sufficient for 1,960 cases.

TABLE I.

Showing NUMBER of CHARGES of GLYCERINATED CALF LYMPH issued to PUBLIC VACCINATORS during the year ended 31st March, 1914.

Monthly Number of Charges.			Quarterly Number of Charges.			Monthly Number of Charges.			Quarterly Number of Charges.		
1913.						1913.					
April	30,733	...	} Second Quarter,	1913.	October	30,743	...	} Fourth Quarter,	1913.		
May	33,495	...		100,179	November	27,965	...		82,111		
June	35,951	...			December	23,403	...				
						1914.					
July	30,122	...	} Third Quarter,	1913.	January	27,004	...	} First Quarter,	1914.		
August	29,199	...		94,646	February	28,294	...		89,780		
September	35,325	...			March	34,482	...				
						366,716			366,716		

TABLE II.

Showing the RESULTS of the USE of GLYCERINATED CALF LYMPH issued to PUBLIC VACCINATORS during the year ended 31st March, 1914.

TOTAL CASES.

Period during which sent out.	Number of cases used for.	Percentage success.	
		Case.	Insertion.
June Quarter 1913	89,764	99·4	96·1
September „ „	81,125	99·3	95·7
December „ „	69,269	99·5	96·5
March „ 1914	78,608	99·1	95·4
Total	318,766	99·3	95·9

PRIMARY CASES.

Period during which sent out.	Number of cases used for.	Percentage success.	
		Case.	Insertion.
June Quarter 1913	86,914	99·4	96·1
September „ „	77,973	99·3	95·8
December „ „	66,859	99·5	96·6
March „ 1914	75,939	99·2	95·5
Total	307,685	99·4	96·0

RE-VACCINATIONS.

Period during which sent out.	Number of cases used for.	Percentage success.	
		Case.	Insertion.
June Quarter 1913	2,850	97·5	94·5
September „ „	3,152	98·0	94·8
December „ „	2,410	98·1	94·7
March „ 1914	2,669	97·3	94·0
Total	11,081	97·8	94·5

APPENDIX A., No. 14.

REPORT by DR. A. EASTWOOD on the WORK of the BOARD'S
PATHOLOGICAL LABORATORY during 1913-14.

During the above year the investigators in the Board's Pathological Laboratory have been mainly occupied with the continuation of research on tuberculosis.

The enquiry, referred to in my reports of the two preceding years, into localised tuberculosis in swine has been completed and published. (Reports to the Local Government Board on Public Health and Medical Subjects. New Series, No. 91.)

A report has also been completed and published on the Incidence and Bacteriological Characteristics of Tuberculous Infection in Children. (Reports to the Local Government Board on Public Health and Medical Subjects. New Series, No. 88.)

In August, 1913, an Enquiry was initiated into 'Tuberculous Disease of Bones and Joints. The main objects of this enquiry are to determine, by examination of a large number of cases, how far the "bovine" and how far the "human" type of tubercle bacillus are to be regarded as responsible for these forms of disease in the human subject, and to ascertain whether cases occur in which the bacillus does not conform to either of these types. Material removed by operation has been obtained from hospitals in various parts of the country and is now under investigation.

In addition to the research work of the laboratory, examination has been made of specimens sent for bacteriological diagnosis.

During July and August, 1913, the Board's Inspectors of Foods sent for examination 51 samples of imported cream, for the purpose of ascertaining whether they contained living tubercle bacilli. It was stated that all the creams from which the samples were taken had been pasteurised and had received an addition of either boric acid or hydrogen peroxide. In every instance the samples were found to be free from tubercle bacilli.

During the year, as in the previous year, material suspected as regards plague was sent for diagnosis from a number of places.

Material from three human cases proved on examination to be negative as regards plague. Material was also examined from 14 rats, 5 ferrets and 1 owl. Of these, 4 rats and 3 ferrets were found to be plague-infected, the remainder negative.

APPENDIX A., No. 15.

DIGEST of the VACCINATION OFFICERS' RETURNS with regard to
CHILDREN whose BIRTHS were REGISTERED in the YEAR 1912.

(Compiled from returns received by the Board in February, 1914.)

	Births.	Successfully vaccinated.	Insusceptible of vaccination.	Had Small-pox.	Number in respect of whom Certificates of Conscientious Objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.
ENGLAND AND WALES.	872,799	436,951	1,367	—	280,529	60,238	12,552	51,162
Ditto (excluding Metropolitan Unions).	759,947	378,039	1,182	—	257,933	52,707	10,606	59,480
METROPOLITAN UNIONS	112,852	58,912	185	—	22,596	7,531	1,946	21,682
REGISTRATION DIVISIONS.								
London	112,852	58,912	185	—	22,596	7,531	1,946	21,682
South Eastern	77,843	39,894	155	—	28,325	4,253	654	4,562
South Midland	58,407	23,548	80	—	25,782	3,172	418	5,407
Eastern	50,477	21,741	65	—	19,579	2,932	370	5,790
South Western	39,729	19,003	54	—	15,721	2,250	546	2,155
West Midland	100,390	50,534	164	—	31,666	7,465	1,298	9,253
North Midland	57,619	16,401	41	—	29,199	4,037	494	7,447
North Western	140,599	82,217	253	—	35,634	11,035	2,248	9,212
York	97,405	48,878	196	—	34,182	7,027	1,243	5,879
Northern	70,026	36,342	123	—	21,981	5,461	1,328	4,791
Welsh†	67,452	39,481	51	—	15,864	5,075	2,007	4,974
REGISTRATION COUNTIES.								
ENGLAND :								
Bedford	4,080	680	1	—	3,011	233	55	100
Berks	6,118	2,399	10	—	2,828	346	39	496
Bucks	3,924	1,425	1	—	2,092	226	25	155
Cambridge	4,558	1,816	6	—	2,320	272	35	109
Chester	20,470	12,802	43	—	4,975	1,417	381	852
Cornwall	6,468	3,071	4	—	2,497	435	103	358
Cumberland	6,356	3,684	5	—	1,809	487	132	239
Derby	13,384	3,366	11	—	4,785	974	95	4,153
Devon	13,800	8,586	37	—	3,416	860	190	711
Dorset	4,303	1,749	2	—	2,083	188	57	224
Durham	43,056	21,590	74	—	14,190	3,413	893	2,896
Essex	31,923	12,906	53	—	11,711	1,716	260	5,277
Gloucester	13,855	4,685	20	—	5,440	907	128	2,675
Hereford	2,344	1,325	3	—	657	138	58	163
Hertford	7,596	3,376	12	—	3,290	386	22	510
Huntingdon	1,036	563	—	—	406	38	9	20
Kent (ex-met.)	21,169	11,197	36	—	7,695	1,179	169	893
Lancaster	120,129	69,415	210	—	30,659	9,618	1,867	8,360
Leicester	11,922	1,153	2	—	7,439	749	116	1,563
Lincoln	13,611	4,379	18	—	7,848	862	88	416
Middlesex (ex-met.)	25,764	12,510	57	—	7,476	1,402	195	4,124
Monmouth	12,617	4,628	8	—	5,621	909	313	1,138
Norfolk	10,379	4,870	5	—	4,392	734	66	312
Northampton	7,496	1,695	2	—	5,133	423	30	213
Northumberland	19,334	10,347	40	—	5,611	1,484	265	1,587
Nottingham	19,191	7,297	10	—	8,945	1,436	194	1,309
Oxford	3,953	1,483	1	—	2,054	192	47	176
Rutland	411	206	—	—	182	16	1	6
Salop	5,786	3,453	6	—	1,677	330	82	238

* The figures in this column have no reference to the other columns

† Monmouth is included in the

PERCENTAGES of BIRTHS registered in 1912.				Total Number of Certificates of Successful Primary Vaccination at ALL AGES received during the calendar year 1913.	
Successfully vaccinated.	Exempted by "Conscientious Objection" Certificates.	Not finally accounted for, including cases postponed.	Unvaccinated.		
(1)	(2)	(3)	(Cols. 2 & 3)		
50.1	32.1	10.7	42.9	430,470	ENGLAND AND WALES.
49.7	33.9	9.2	43.2	372,686	Ditto (excluding Metropolitan Unions).
52.2	20.0	20.9	41.0	57,784	METROPOLITAN UNIONS.
					REGISTRATION DIVISIONS.
52.2	20.0	20.9	41.0	57,784	London.
51.2	36.4	6.7	43.1	40,833	South Eastern.
40.3	44.1	10.0	54.1	23,327	South Midland.
43.1	38.8	12.2	51.0	22,702	Eastern.
47.8	39.6	6.8	46.4	18,841	South Western.
50.3	31.5	10.5	42.1	49,532	West Midland.
28.5	50.7	13.8	64.5	15,678	North Midland.
58.5	25.3	8.2	33.5	82,263	North Western.
50.2	35.1	7.3	42.4	46,615	York.
51.9	31.4	8.7	40.1	34,142	Northern.
58.5	23.5	10.3	33.9	38,753	Welsh.†
					REGISTRATION COUNTIES.
					ENGLAND :
16.7	73.8	3.8	77.6	642	Bedford.
39.2	46.2	8.7	55.0	2,639	Berks.
36.3	53.3	4.6	57.9	1,474	Bucks.
39.8	50.9	3.2	54.1	1,767	Cambridge.
62.5	24.3	6.0	30.3	13,294	Chester.
47.5	38.6	7.1	45.7	3,097	Cornwall.
58.0	28.5	5.8	34.3	3,513	Cumberland.
25.1	35.8	31.7	67.5	3,182	Derby.
62.2	24.8	6.5	31.3	8,461	Devon.
40.6	48.4	6.5	54.9	1,661	Dorset.
50.1	33.0	8.8	41.8	19,894	Durham.
40.4	36.7	17.3	54.0	13,820	Essex.
33.8	39.3	20.2	59.5	4,727	Gloucester.
56.5	28.0	9.4	37.5	1,363	Hereford.
44.4	43.3	7.0	50.3	3,107	Hertford.
54.3	39.2	2.8	42.0	496	Huntingdon.
52.9	36.4	5.0	41.4	11,324	Kent (ex.-met.)
57.8	25.5	8.5	34.0	68,969	Lancaster.
10.5	67.5	15.2	82.7	1,215	Leicester.
32.2	57.7	3.7	61.4	4,251	Lincoln.
48.6	29.0	16.8	45.8	12,478	Middlesex (ex.-met.).
36.7	44.6	11.5	56.1	4,325	Monmouth.
46.9	42.3	3.6	45.9	4,895	Norfolk.
22.6	68.5	3.2	71.7	1,819	Northampton.
53.5	29.0	9.6	38.6	10,100	Northumberland.
38.0	46.6	7.8	54.4	6,826	Nottingham.
37.5	52.0	5.6	57.6	1,544	Oxford.
50.1	44.3	1.7	46.0	204	Rutland.
59.7	29.0	5.5	34.5	3,291	Salop.

in the table, which refer strictly to the births registered in 1912.
Welsh Registration Division.

		Births.	Successfully vaccinated.	Insusceptible of vaccination.	Had Small-pox.	Number in respect of whom Certificates of Conscientious Objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.
REGISTRATION COUNTIES—<i>cont.</i>									
ENGLAND—<i>cont.</i>									
Somerset ...	...	9,352	3,723	7	—	4,550	474	143	455
Southampton ...	...	19,425	11,477	52	—	5,893	1,066	175	762
Stafford ...	...	33,817	14,670	33	—	13,238	2,740	700	2,436
Suffolk ...	...	8,175	3,965	7	—	3,476	482	44	201
Surrey (ex.-met.) ...	...	19,196	10,195	44	—	6,298	1,050	167	1,442
Sussex ...	...	11,935	4,626	13	—	5,611	612	104	969
Warwick ...	...	32,109	18,877	64	—	7,369	2,484	221	3,094
Westmorland ...	...	1,280	721	4	—	371	77	38	69
Wilts ...	...	5,806	1,874	4	—	3,175	293	53	407
Worcester ...	...	12,479	7,524	38	—	3,285	866	109	657
York, East Riding ...	...	12,963	7,544	45	—	3,251	934	100	1,089
York, North Riding ...	...	10,954	5,121	9	—	3,943	881	237	763
York, West Riding ...	...	73,488	36,213	142	—	26,988	5,212	906	4,027
WALES :									
Anglesey ...	...	714	597	—	—	42	54	12	9
Brecknock ...	...	1,309	645	—	—	366	95	20	185
Cardigan ...	...	1,114	878	—	—	114	75	31	16
Carmarthen ...	...	4,458	3,484	2	—	286	367	205	114
Carnarvon ...	...	2,721	2,124	2	—	281	208	43	63
Denbigh ...	...	2,598	1,464	2	—	865	175	30	62
Flint ...	...	2,520	1,620	—	—	514	171	106	109
Glamorgan ...	...	34,411	20,647	33	—	6,986	2,695	1,094	2,956
Merioneth ...	...	1,223	847	1	—	159	89	60	67
Montgomery ...	...	1,273	823	—	—	223	85	8	134
Pembroke ...	...	2,075	1,493	3	—	275	122	79	103
Radnor ...	...	419	231	—	—	132	30	6	20

* The figures in this column have no reference to the other columns

PERCENTAGES of BIRTHS registered in 1912.				Total Number of Certificates of Successful Primary Vaccination at ALL AGES received during the calendar year 1913.	
Success-fully vacci-nated.	Exempted by "Con-scientious Objection" Certificates.	Not finally accounted for, including cases postponed.	Unvacci-nated.		
(1)	(2)	(3)	(Cols. 2 & 3)		
				*	REGISTRATION COUNTIES— <i>cont.</i>
					ENGLAND— <i>cont.</i>
39·8	48·7	6·4	55·0	3,596	Somerset.
59·1	30·3	4·8	35·1	11,484	Southampton.
43·4	39·1	9·3	48·4	14,383	Stafford.
48·5	42·5	3·0	45·5	3,987	Suffolk.
53·1	32·8	8·4	41·2	10,285	Surrey (ex.-met.).
38·8	47·0	9·0	56·0	5,101	Sussex.
58·8	22·9	10·3	33·3	18,496	Warwick.
56·3	29·0	8·4	37·3	635	Westmorland.
32·3	54·7	7·9	62·6	2,026	Wilts.
60·3	26·3	6·1	32·5	7,272	Worcester.
58·2	25·1	9·2	34·3	7,379	York, East Riding.
46·8	36·0	9·1	45·1	4,984	York, North Riding.
49·1	36·7	6·7	43·4	34,252	York, West Riding.
					WALES :
83·6	5·9	2·9	8·8	619	Anglesey.
49·3	28·0	15·5	43·5	721	Brecknock.
78·8	10·2	4·2	14·5	809	Cardigan.
78·2	6·4	7·2	13·6	3,581	Carmarthen
78·1	10·3	3·9	14·2	2,046	Carnarvon.
56·4	33·3	3·5	36·8	1,356	Denbigh.
64·3	20·4	8·5	28·9	1,569	Flint.
60·0	20·3	11·8	32·1	20,568	Glamorgan.
69·3	13·0	10·4	23·4	775	Merioneth.
64·7	17·5	11·2	28·7	851	Montgomery.
72·0	13·3	8·8	22·0	1,385	Pembroke.
55·1	31·5	6·2	37·7	148	Radnor.

in the table, which refer strictly to the births registered in 1912.

METROPOLITAN UNIONS.			Births.	Successfully vaccinated.	Insusceptible of vaccination.	Had Small-pox.	Number in respect of whom Certificates of Conscientious Objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.
Bermondsey	...	...	3,865	2,594	10	—	408	267	27	559
Bethnal Green	...	...	3,733	1,324	5	—	831	319	144	1,110
Camberwell	...	...	6,338	2,675	10	—	1,589	384	173	1,507
Chelsea	...	...	1,178	801	2	—	225	70	9	71
Fulham	...	...	4,127	2,622	8	—	654	279	69	495
George's, St., Hanover Square.	...	...	1,722	1,327	3	—	195	110	9	78
George, St., in the East	...	...	1,504	931	—	—	118	141	20	244
Giles, St., & St. George	...	...	787	472	2	—	90	42	2	179
Greenwich	...	...	4,808	2,963	13	—	855	314	30	633
Hackney	...	...	6,503	2,381	1	—	2,343	442	126	1,210
Hammersmith	...	...	2,790	1,672	—	—	545	183	12	378
Hampstead	...	...	1,232	826	10	—	249	46	7	94
Holborn	...	...	3,653	1,685	4	—	406	266	123	1,169
Islington	...	...	7,878	3,995	15	—	1,646	491	69	1,662
Kensington	...	...	3,116	2,289	9	—	337	207	37	237
Lambeth	...	...	8,259	4,172	17	—	1,535	494	104	1,937
Lewisham	...	...	3,632	1,947	11	—	943	181	4	543
London, City of	...	...	410	219	—	—	63	32	—	96
Marylebone, St.	...	...	4,090	3,158	3	—	297	224	130	278
Mile End Old Town	...	...	3,890	1,505	2	—	572	251	276	1,284
Paddington	...	...	2,808	1,990	5	—	388	185	34	206
Pancras, St.	...	...	5,079	2,318	4	—	1,060	352	171	1,174
Poplar	...	...	4,911	1,490	5	—	1,928	365	115	1,008
Shoreditch	...	...	3,420	1,164	5	—	710	344	36	1,161
Southwark	...	...	5,329	2,465	8	—	752	407	25	1,672
Stepney	...	...	1,623	454	2	—	551	127	6	483
Strand	...	...	150	95	1	—	35	10	—	9
Wandsworth	...	...	10,708	5,787	15	—	2,259	697	168	1,782
Westminster	...	...	283	215	1	—	21	10	—	36
Whitechapel	...	...	2,010	1,459	1	—	91	143	5	311
Woolwich	...	...	3,016	1,867	10	—	900	148	15	76
			112,852	58,912	185	—	22,596	7,531	1,946	21,682

* The figures in this column have no reference to the other columns

PERCENTAGES of BIRTHS registered in 1912.				Total Number of Certificates of Successful Primary Vaccination at ALL AGES received during the calendar year 1913.	METROPOLITAN UNIONS.
Success- fully vacci- nated.	Exempted by "Con- scientious Objection" Certificates.	Not finally accounted for, including cases postponed.	Unvacci- nated.		
(1)	(2)	(3)	(Cols. 2 & 3)	*	
67·1	10·6	15·2	25·7	2,513	Bermondsey.
35·5	22·3	33·6	55·9	1,482	Bethnal Green.
42·2	25·1	26·5	51·6	2,485	Camberwell.
68·0	19·1	6·8	25·9	877	Chelsea.
63·5	15·8	13·7	29·5	2,430	Fulham.
77·1	11·3	5·1	16·4	1,192	George's; St., Hanover Square.
65·2	7·8	17·6	25·4	996	George, St., in the East.
60·0	11·4	23·0	34·4	328	Giles, St., & St. George.
61·6	17·8	13·8	31·6	2,904	Greenwich.
36·6	36·0	20·5	56·6	2,475	Hackney.
59·9	19·5	14·0	33·5	1,787	Hammersmith.
67·0	20·2	8·2	28·4	817	Hampstead.
46·1	11·1	35·4	46·5	1,730	Holborn.
50·7	20·9	22·0	42·9	3,806	Islington.
73·5	10·8	8·8	19·6	2,152	Kensington.
50·5	18·6	24·7	43·3	4,113	Lambeth.
53·6	26·0	15·1	41·0	1,804	Lewisham.
53·4	15·4	23·4	38·8	190	London, City of.
77·2	7·3	10·0	17·2	3,036	Marylebone, St.
38·7	14·7	40·1	54·8	1,623	Mile End Old Town.
70·9	13·8	8·5	22·4	1,848	Paddington.
45·6	20·9	26·5	47·4	2,197	Pancras, St.
30·3	39·3	22·9	62·1	1,916	Poplar.
34·0	20·8	35·0	55·8	1,076	Shoreditch.
46·3	14·1	31·8	46·0	2,293	Southwark.
28·0	33·9	30·1	64·1	490	Stepney.
63·3	23·3	6·0	29·3	91	Strand.
54·0	21·1	18·2	39·3	5,732	Wandsworth.
76·0	7·4	12·7	20·1	171	Westminster.
72·6	4·5	15·7	20·2	1,421	Whitechapel.
61·9	29·8	3·0	32·8	1,809	Woolwich.
52·2	20·0	20·9	41·0	57,784	

in the table, which refer strictly to the births registered in 1912.

APPENDIX A., No. 16.

CIRCULARS, MEMORANDA, and ORDERS issued by the LOCAL GOVERNMENT BOARD in the Year 1913-14 relating to QUESTIONS affecting the PUBLIC HEALTH.

1. Receptacles for Poisonous Liquids intended to be used for purposes of disinfection. Circular to Sanitary Authorities. (14th April, 1913.) Enclosure : Order in Council. (11th October, 1912.)

Prescribing that as from 1st May, 1913, all liquid preparations sold as carbolic or carbolic acid or carbolic substitutes or carbolic disinfectants, containing not more than 3 per cent. of phenols, shall be substances to which section 5 of the Poisons and Pharmacy Act, 1908, applies.

2. Maintenance Grants towards cost of Sanatorium Schemes. Circular to County and County Borough Councils (England). (13th May, 1913.) Circular to Metropolitan Borough Councils. (14th May, 1913.) Enclosures : Forms C and D.

Requiring details of expenditure incurred or proposed in regard to schemes for the institutional treatment of tuberculosis.

3. Epidemic Diarrhœa : Feeding of Infants : Notification of Births Act, 1907. Circular to Sanitary Authorities. (25th July, 1913.)

Calling attention to the importance of taking all practicable measures for the prevention of epidemic diarrhœa and of promoting hygienic conditions in the feeding of infants.

4. Legislation in 1913. Circular to County, Town, and Urban and Rural District Councils. (23rd September, 1913.)

5. Arrangements for drainage and disposal of waste matters at public elementary schools for which loans under the Board's sanction are required, with especial reference to schools in country places where sewers and water services are not available. Memorandum. (October, 1913.)

6. Regulations under the Public Health (Regulations as to Food) Act, 1907. Milk and Cream. Circular to County and Borough Councils (Sale of Food and Drugs Acts Authorities). (27th October, 1913.)

Advising as to the administration of the Public Health (Milk and Cream) Regulations, 1912, and as to the manner in which the details of action taken under the Regulations can be most conveniently reported.

[Reproduced on page 111.]

7. Treatment of Tuberculosis. Circular to County and County Borough Councils. (England.) (7th November, 1913.) Enclosures : Forms E and F.

Detailing the arrangements proposed in regard to the distribution of the maintenance grant towards the cost of schemes for the institutional treatment of tuberculosis, and advising as to the organisation and development of such schemes.

8. Scavenging. Circular to Borough and Urban District Councils. (4th December, 1913.)

Asking for return as to the arrangements made for scavenging.

9. Annual Reports of Medical Officers of Health. Circulars to Medical Officers of Health of Counties, Metropolitan Boroughs, Boroughs, Combined Districts, Port Sanitary Districts, and Urban and Rural Districts. (15th December, 1913.) Enclosures: Revised Memorandum (Provinces) as to Annual Reports of Medical Officers of Health. (December, 1913.) Forms for Tables of Vital Statistics, and for particulars as to Factories and Workshops for the Secretary of State, Home Office.

Separate circulars issued annually to the medical officers of health of the various sanitary authorities reminding them of the statutory requirements as to their annual reports and drawing their attention to particular subjects on which specific information is desired. Memorandum prescribes the subjects on which the Board require information in the annual reports and explains the forms for vital statistics.

10. Canal Boats Acts. Circular to Borough and District Councils. (15th December, 1913.)

Describing the information desired in annual reports under section 3 of the Canal Boats Act, 1884.

11. Sale of Food and Drugs Acts. Circular to County and Borough Councils. (17th December, 1913.)

Setting out the information required to be furnished to the Board with the quarterly reports of the public analysts.

12. Treatment of Tuberculosis in London. Circular to Metropolitan Borough Councils. (19th December, 1913.)

Advising as to the lines upon which the arrangements for providing dispensaries for the treatment of tuberculosis should be developed.

13. Housing, Town Planning, &c. Act, 1909. Memorandum relative to the operation of the Act. (31st December, 1913.)

14. Voluntary Health Associations. Circular to the Mayors of Metropolitan Boroughs and the Chairmen of Metropolitan Boards of Guardians. (21st January, 1914.) Enclosure: Return of Voluntary Health Societies in London.

Drawing attention to the advantage to be derived from co-operation between local authorities and voluntary workers.

15. Public Health (Ophthalmia Neonatorum) Regulations, 1914. Circular to Sanitary Authorities. (6th February, 1914.) Enclosure: General Order No. 60,088. (5th February, 1914.)

Requiring general notification of ophthalmia neonatorum.

16. Sanatoria. Circular to County, Town, Metropolitan Borough and Urban and Rural District Councils. (10th February, 1914.) Enclosure: List of Sanatoria approved by the Board under the National Insurance Act, 1911. (31st January, 1914.)

17. Provision of Institutions for the Treatment of Tuberculosis. Circular to County and County Borough Councils (England). (13th February, 1914.) Enclosure: Memorandum on Provision of New Residential Institutions for the Treatment of Pulmonary Tuberculosis. (February, 1914.)

[Memorandum reproduced on page 128.]

18. Housing of the Working Classes Acts. Circular to Town, Metropolitan Borough and District Councils. (27th February, 1914.) Enclosure : Form of return.

Asking for particulars as to inspection of houses and housing conditions.

19. Regulations under the Public Health (Regulations as to Food) Act, 1907. Foreign Meat. Circular to Port and certain Sanitary Authorities. (13th March, 1914.)

Describing labels admissible as "official certificates" in respect of pork, &c., which has been subjected to inspection in certain Russian slaughterhouses.

[Reproduced on page 113.]

20. Treatment of Tuberculosis. Circular to County and County Borough Councils (England). (31st March, 1914.) Enclosure : Form of return.

Asking for particulars of the scheme of institutional treatment of tuberculosis which has been adopted by the council, and the number of persons treated and under treatment in residential institutions and dispensaries.

MEMORANDUM ON PROVISION OF NEW RESIDENTIAL INSTITUTIONS FOR THE TREATMENT OF PULMONARY TUBERCULOSIS.

In a previous memorandum, dated the 25th February, 1913, it was indicated in a general way how inexpensive sanatorium accommodation for tuberculous persons could be erected within a comparatively short period in order to meet any pressing need in a particular locality.

The present memorandum has been prepared with a view to affording local authorities and others further assistance in the provision of special residential institutions in connection with permanent schemes for the treatment of pulmonary tuberculosis. The unit taken in setting out the details has been 100 beds in buildings, with 10 additional beds in shelters. For institutions containing a larger number of beds, *see* the second paragraph on page .

Economy in building.

In preparing this memorandum, economy has been borne in mind throughout, but, it is believed, without any sacrifice of efficiency. The cost of an institution—apart from the cost and character of the site—depends primarily on its planning : after this on the character of the materials used in its construction. The local circumstances must be taken into account in determining the choice of building materials.

Site.

In the selection of a site the most important considerations to be taken into account are—

- (1) Area.
- (2) Elevation in relation to surrounding country.
- (3) Cheerfulness of outlook.
- (4) Protection from certain winds.
- (5) Subsoil.
- (6) Drainage facilities.
- (7) Water supply.
- (8) Convenience of access.

(1) The area of land required for the site will depend upon the number of patients and the type of cases.

The site of a sanatorium should be sufficiently large to permit of open-air employment of a considerable number of patients. It is desirable that a site of 50 acres in extent should be provided for 100 patients if land is readily available and the cost is low, but an area of not less than 20 acres may suffice for this number of patients where suitable land is difficult to obtain or the cost of land is high. It is desirable that in all cases an area of at least one-fifth of an acre should be allowed per patient.

(2), (3) and (4) The site should preferably slope gradually to the south and be protected on the north and east by high ground, preferably wooded. In some

districts protection from westerly and south-westerly gales may be desirable. The site should be moderately elevated above the country lying to the south of it.

(5) The subsoil has importance, not only as regards dampness or dryness, but also because the cost of building may depend somewhat upon its character. The main consideration is that the site should be dry. This must be secured if necessary by proper drainage, but a site requiring extensive drainage should, as a rule, be avoided.

(6) If drainage into a public sewer is impracticable, the site should be suitable for the provision of an adequate sewage disposal system.

(7) It will be necessary to ascertain that an abundant supply of pure water is available.

(8) The site should, if possible, be within easy reach of a railway station. The cost of carriage from the station to the site will form an important factor, not only as regards construction, but also in the subsequent maintenance of the institution. There is the further consideration that it is undesirable that patients who are acutely ill should be unduly remote from their relatives.

Buildings.

In residential institutions for the treatment of pulmonary tuberculosis the following provision will be required:—

- (1) Patients' sleeping accommodation.
- (2) Kitchen, dining hall, and offices.
- (3) Staff block containing quarters for Resident Medical Officer, Matron, and Staff.
- (4) Out-buildings, including laundry, boiler house, disinfecter, sputum destructor, mortuary, &c.

General Considerations as to Accommodation for Patients.

As the planning of the institution will depend on the stage of disease of the tuberculous patients proposed to be admitted to it, it is necessary to set out a classification of cases of pulmonary tuberculosis arranged from the standpoint of accommodation in residential institutions.

Group A. *Cases in which permanent improvement or recovery may usually be anticipated.*

Group B. *Cases in which only temporary, though possibly prolonged, improvement may be anticipated.*

Such cases will include:—

- (1) Patients who may be expected to recover considerable ability to work, as a result of protracted treatment.
- (2) Patients admitted for a short term for educational treatment.
- (3) Patients with advanced disease, many of whom improve greatly under institutional treatment.

Group C. *Advanced cases requiring continuous medical care and nursing.*

Group D. *Cases requiring special observation.*

- (1) Patients admitted for the purpose of diagnosis.
- (2) Patients needing to be watched, before the best form of continued treatment can be determined.

"Emergency" cases, *e.g.*, patients with hæmoptysis, &c., may come within any of the above groups.

For the sake of clearness, the term *sanatorium* is used hereafter to indicate an institution mainly devoted to the reception of patients in Group A, the term *hospital* to indicate an institution provided for the reception of patients in Groups B, C, and D, and the term *combined institution* to indicate an institution devoted to the reception of patients in all four groups.

Very commonly, however, patients in Group B (1) are treated in institutions intended for patients in Group A; but the advantage of the protracted treatment of patients in the former group in a *sanatorium* is somewhat doubtful. Occasionally patients in Group D may be received into a *sanatorium*, but such patients are usually better treated in a *hospital*, situated nearer the patient's home than the *sanatorium*, when both institutions are available.

The patients in all four groups may be treated in a *combined institution*, in separate rooms or pavilions. This arrangement is most suitable for areas with a population too small to require the provision of 100 beds for patients in Group A. A *combined institution* should be so situate as to secure fairly easy access of relatives to patients acutely ill, while giving good local conditions for patients in Group A.

Children's Pavilion.—If it is desired to make provision for children, whether on the site of a residential institution for adults or on a different site, the Board of Education should be consulted.

Sleeping Accommodation for Patients.

The sleeping accommodation provided in residential institutions for the treatment of pulmonary tuberculosis is commonly of one or more of the following types:—

I. Single-bedded rooms; II. Two-bedded rooms; III. Beds on both sides of a ward as in the ordinary isolation hospital; IV. Shelters.

I. Single rooms are often desirable for patients who require a considerable amount of nursing whether in Groups A, B or C. These rooms should be situated in the special nursing section. Single rooms may also be required for patients in Group D. The rooms for patients in Group D need not all be situated in the special nursing block.

II. Two-bedded rooms are suitable for all types of patients with the exception of the cases referred to above for whom single rooms are required.

III. Wards will generally be found useful for patients in Group B who are able to be up and about all day. They may also be used for some of the patients in Group A. If the wards are situated near a nurse's duty room they may also be suitable for patients in Group B who require only a limited amount of nursing, and are not sufficiently ill to make the use of single-bedded rooms desirable.

IV. Shelters single or double-bedded are suitable for patients in Groups A and B who are able to be up and about all day. Single-bedded shelters may also be useful for doubtful cases sent for diagnosis (Group D (1)) and for training patients with a view to the subsequent use of shelters at home.

Shelters.—Owing to difficulties in supervision and administration it is undesirable to have a large proportion of the sleeping accommodation in shelters, and as a rule provision of this kind should not exceed 10 per cent. of the total accommodation. Electric bell communication should be provided between each shelter and the nurses' duty room. These shelters may be used for training patients, about to leave the sanatorium, to sleep in shelters after their return home. It is desirable, therefore, that the shelter used should be simple in construction, and similar to those lent out for use at home.

In deciding upon the kind and the proportional amount of the different types of sleeping accommodation the following general considerations should be borne in mind:—

(1) It is desirable that patients in different stages of disease should as far as practicable be treated in different wards or rooms.

(2) It is desirable, in order to secure adequate and continuous attention to patients along with economy of staff, that, so far as practicable, all patients requiring special nursing should be treated in a section of the institution devoted to this purpose.

(3) Subject to the foregoing considerations there is no administrative or other difficulty in having patients in different stages of disease in the same pavilion.

The term "nursing section or pavilion" is used throughout this memorandum to refer to that portion of the institution set aside for the treatment of those patients who are not able to be up and about all day but require a certain amount of special nursing or supervision, and the term "convalescent section or pavilion" to that portion of the institution allocated to patients who are able to be up and about all day and to take all their meals in the dining hall.

The special nursing section should be quiet and not liable to disturbance from the passing to and fro of other patients, and should be sufficiently near the central kitchen to permit easy service.

For a *sanatorium*, about 20 per cent. of the sleeping accommodation for patients should be in the special nursing section; for a *combined institution*, it is desirable that about 36 per cent. of the sleeping accommodation should be so placed.

In a *combined institution*, it is undesirable that any special pavilion or section should be used exclusively for patients with advanced disease. The pavilion or section used for these patients should also include accommodation in separate rooms for patients in Groups A, B, or D, requiring special nursing, rest in bed or supervision. If this is done patients will not be led to suppose from the place where they are being treated that their cases are hopeless.

Types of Buildings.

The drawings which accompany this memorandum aim at giving an indication of the lines on which buildings for this purpose may be designed and it is hoped that these may be of service to those who are engaged in the provision of institutions for tuberculous patients.

The following plans are appended to the memorandum :—

- A. Block plan of a 100 bed sanatorium with three separate pavilions.
- B. Block plan of a 100 bed sanatorium with a single pavilion.
- C. Ground plan of Staff Block.
- D. First floor plan of Staff Block.
- E. Plan of Dining-hall and Kitchen Block.
- F. Plan of Nursing Pavilion for 36 beds.
- G. Plan of Convalescent Pavilion for 32 beds.
- H. Plan of two-storied pavilion for 100 beds.
- I. Ditto (alternative design).

It will not usually be practicable to provide in a single one-storied building 100 beds in rooms or wards with beds arranged on one side only. Such an arrangement would necessitate a very long building, which may be expensive to construct, except on a level site, and which would be inconvenient to administer. For an institution for 100 patients it will often be preferable to arrange for three separate pavilions (Scheme I); under some circumstances it may be found desirable to provide the accommodation in one two-storied building (Scheme II).

If an institution for more than 100 beds is required, it will usually be preferable to adopt a modification of Scheme I, with at least three pavilions: one a special nursing section, and two separate pavilions for males and females respectively.

Schemes I and II have both been prepared upon the assumption that equal accommodation will be required for each sex. They may require modification in this respect according to local needs.

An arrangement is also shown by which 10 beds between the duty rooms in the special nursing pavilion in Plan F and in the central section of the ground floor in Plans H and I, ordinarily intended in each instance for 5 male and 5 female patients, can be utilised either entirely for male or entirely for female patients, as occasion may require. Some elasticity in the amount of accommodation for the two sexes is thus secured.

SCHEME I.

(Details of the various blocks are given in plans C, D, E, F and G.)

Scheme I has been prepared to secure the advantages to be obtained by having one pavilion for patients requiring special nursing or supervision and two additional pavilions for male and female patients respectively, who are able to be up and about all day. This arrangement makes for efficiency and economy in nursing, and secures separation of the sexes more efficiently than is possible if all patients are treated in the same building.

It has been prepared for a *combined institution* and shows a special nursing pavilion for 36 patients, a pavilion for 32 male and a pavilion for 32 female patients. The plan can be modified so as to make it suitable for a *sanatorium*, by reducing the accommodation in the special nursing pavilion to about 20 beds and by increasing that in the separate pavilions for male and female patients.

The block plan shows that the central portion of the site is occupied by the staff block, kitchen and dining-hall block, and out-buildings, and by the special nursing pavilion; the eastern and western sections are occupied by the separate convalescent pavilions for male and female patients respectively. The portions of the site devoted to male and female patients are thus separated, so far as possible, by administrative and other buildings.

Special Nursing Pavilion (Plan F).—For convenience of service this pavilion is connected with the centrally situated kitchen and dining hall block by a covered way about 60 feet in length. The plans show a central service kitchen. On either side of this kitchen is provided a nurse's duty room and accommodation for 10 patients in four double-bedded and two single-bedded rooms. It is intended that this central section should be used for those patients who are acutely ill. The north verandah will be useful for nurses attending on the patients. At the end of this verandah a hospital slop sink has been provided. It is desirable that arrangements should be made for heating some of these bedrooms.

At each end of these centrally situated rooms is a lavatory section; and, beyond this, in the wings is accommodation for those patients who require only a moderate amount of nursing. This accommodation may be provided either in double-bedded rooms or in small wards. The latter arrangement is shown on Plan F.

The section between the service kitchen and the duty room on each side is practically cut off from the section beyond the duty room. A small lavatory annexe situated behind the service kitchen, and containing two w.c.s and one bath room, has been provided for these sections. This arrangement makes it possible to use these sections entirely for male or entirely for female patients or for five patients of each sex. In the event of the sections being occupied by patients of different sexes, each section would have a separate w.c., but the bathroom would be common to the two.

*Convalescent Pavilions (Plan G).—*The sleeping accommodation is shown partly in double-bedded rooms and partly in a small ward. As patients occupying these pavilions will be able to take their meals in the dining hall no provision has been made for the service of food, and the pavilions need not be situated close to the central kitchen block. No provision has been made in these pavilions for special nursing, as it is assumed that patients requiring this will be transferred to the special nursing pavilion.

SCHEME II.

(Details of the various blocks are given in plans C, D, E, H, and I.)

Plans of a two-storied building have been prepared to meet those cases where local circumstances make it desirable to provide the whole of the sleeping accommodation for patients in a single building. The plans have been prepared for a *sanatorium*. If it is proposed to use such a two-storied building as a *combined institution*, the plan can be modified to secure more accommodation on the ground floor, within the special nursing section.

Provision has been made for a centrally situated special nursing section on the ground floor. The general arrangement of this section is similar to that of the special nursing pavilion included in Scheme I. Arrangements have been made for the accommodation of patients needing little nursing supervision on the first floor and in the wings on the ground floor. As it is suggested that the first floor shall be used only by patients who are able to be up and about, only narrow balconies for access to the rooms have been provided in order that the lighting and ventilation of the ground floor rooms may not be materially interfered with.

It will be noted that the plan of the first floor differs from that of the ground floor, only one duty room having been provided.

General Observations.

Space for patients and height of walls.—The accommodation should be so arranged that a floor space of at least 64 square feet will be available for each patient: the distance between the centres of the heads of any two adjoining beds should not be less than eight feet measured along the wall behind the heads of the beds.

Patients' rooms should not be less than 8 feet 6 inches high: wards should be higher, but may be carried partly into the roof and ventilated by openings in the gable end.

Doors should be made on the "stable door" pattern so that in inclement weather the lower portion may be closed while the upper portion is left open. They should be constructed in the form of French casements with a clear opening of not less than 3 feet 6 inches, so that beds may easily be wheeled through them.

Windows should preferably be of the casement pattern, and be hung "to fold" without mullions.

Baths should be provided on a scale of about one to twelve patients. They may be of enamelled iron and should be fitted with large taps and wastes to facilitate filling and emptying. Spray baths may also be provided.

There should be at least one water-closet for every twelve patients. Hospital slop sinks should be provided in the special nursing pavilion.

Every institution should have ample storeroom accommodation for linen, clothes, &c., and lockers for boots and shoes. The provision of some arrangement for drying patients' clothes will also be advisable.

Day Shelters.—The question as to whether day shelters shall be provided will require consideration for each proposed institution: if verandah accommodation is not adequate, day shelters will be needed. These should be of inexpensive construction.

Recreation Rooms.—In view of the importance of continuous open air treatment of patients, it is unwise to encourage them to collect in a recreation room, except for a very limited time, or on special occasions. In view of these considerations the dining room has frequently been regarded as sufficing for the use of patients for recreation, lectures, &c. If it is considered necessary to provide special recreation rooms for use on wet days, or in winter evenings, these may conveniently be added at the ends of the pavilions for convalescent patients.

Kitchen and dining hall accommodation (Plan E).—The block containing the patients' dining hall and kitchen for patients and staff should preferably be a one-storey building, which should be placed near to the administrative block and to the rooms for patients requiring special nursing. It may be connected with the special nursing pavilion, if desirable, by a covered way.

The dining hall should, if practicable, have a southerly aspect.

The consulting room, dispensary and laboratory, which should be centrally situated, may also conveniently be included in this block.

Unless other accommodation is available for the male domestic staff provision may be made for them in an upper floor of the kitchen and dining hall block above the store rooms, &c.

Staff block (Plans C and D).—The position of this building should be selected with a view to giving the greatest facilities for economical service and administration. The accommodation for a sanatorium with 110 beds will include medical officer's quarters, offices, matron's quarters, dining room for nurses, bedroom accommodation for the nurses and servants. Each nurse should have a separate bedroom of an area of about 100 square feet. Usually one nurse will be required for 12 patients; but more will be needed if a considerable number of patients with advanced disease are being treated. Baths and water closets should be provided in the proportion of not less than one to each 12 nurses or servants.

It is desirable that the principal cooking for the staff should be done in the central kitchen block, so that a separate fully equipped kitchen is not required in the administrative block. A small kitchen pantry with food store is shown on the plan adjoining the nurses' dining room. This could be provided with a small range or gas cooker for minor cooking.

Out-buildings.—The laundry should consist of receiving room and washhouse, drying room, and ironing and delivery room. Mortuary accommodation may be provided in the same block.

The amount of boiler house accommodation will depend on the amount of steam required for laundry, disinfecter, heating and hot water supply and for driving dynamos if electric current is to be generated in this way for lighting or other purposes. Special provision should be made for the sterilisation of sputum and for the cleansing of sputum cups. Unless suitable arrangements are available elsewhere some form of disinfecter for clothing and bedding should be provided.

Hot water supply.—An ample and constant supply of hot water is desirable and the system should be capable of easy extension.

Heating and lighting.—It will usually be unnecessary to heat the patients' quarters excepting the dining hall and some of the rooms for patients requiring special nursing. A system of low pressure hot water heating will be found most economical for this purpose.

Electric lighting should be employed where electric current is available or can be produced economically. It may be necessary to use coal gas, acetylene or petrol air gas: these illuminants have been found to be fairly satisfactory for use in sanatoria if suitable fittings are provided and adequate precautions are taken against fire.

Construction.—Where, owing to local circumstances, the use of brickwork would be economical, cheap bricks may often be employed faced externally, if necessary, with rough cast or cement. Walls in exposed positions should be of hollow construction.

In some districts other materials may be less expensive and may be employed, such as steel framing carrying terra-cotta slabs, or concrete slabs or blocks plastered internally and cemented externally, or timber-framing lined internally with asbestos sheeting or expanded metal lathing plastered with a hard setting plaster, rough-cast or coated externally with weather boarding chemically treated. The roofs should be of simple construction and may be covered with slates, tiles or asbestos material. The floors of verandahs should be of impermeable material.

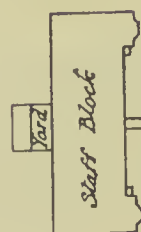
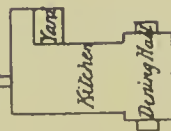
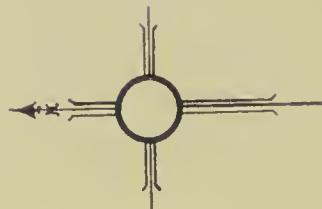
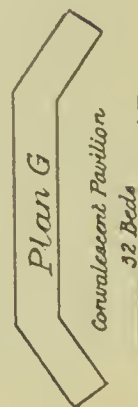
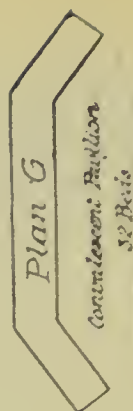
BROOK KITCHIN,
Architect to the Board.

ARTHUR NEWSHOLME,
Medical Officer to the Board.

Local Government Board,
February, 1914.

BLOCK PLAN, SCHEME I.

PLAN "A."

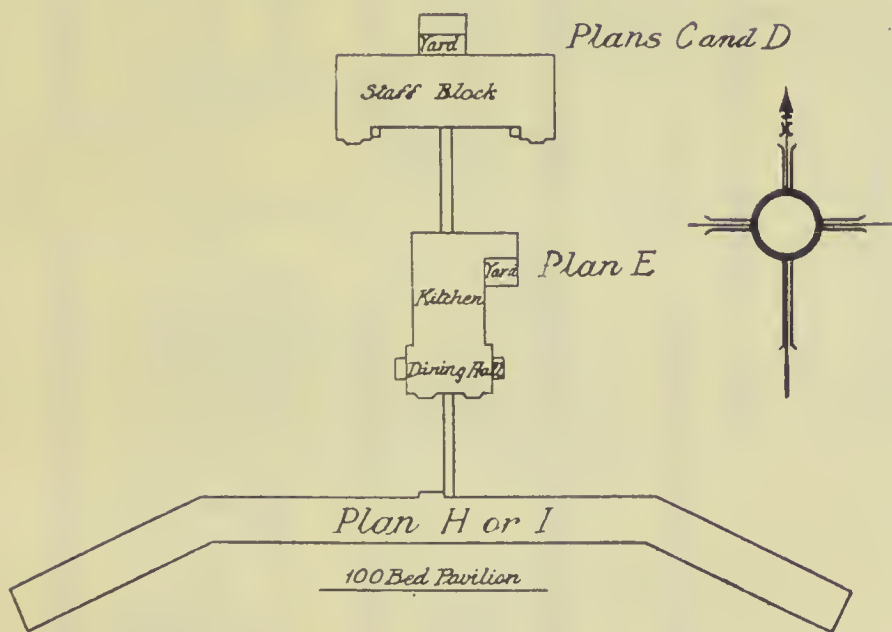
*Laundry, Boiler House, &c.**Plans C and D**Plan E**Plan F**Nursing Pavilion 36 Beds*

Scale, 1/32 Feet = 1 Inch.

BLOCK PLAN, SCHEME II.

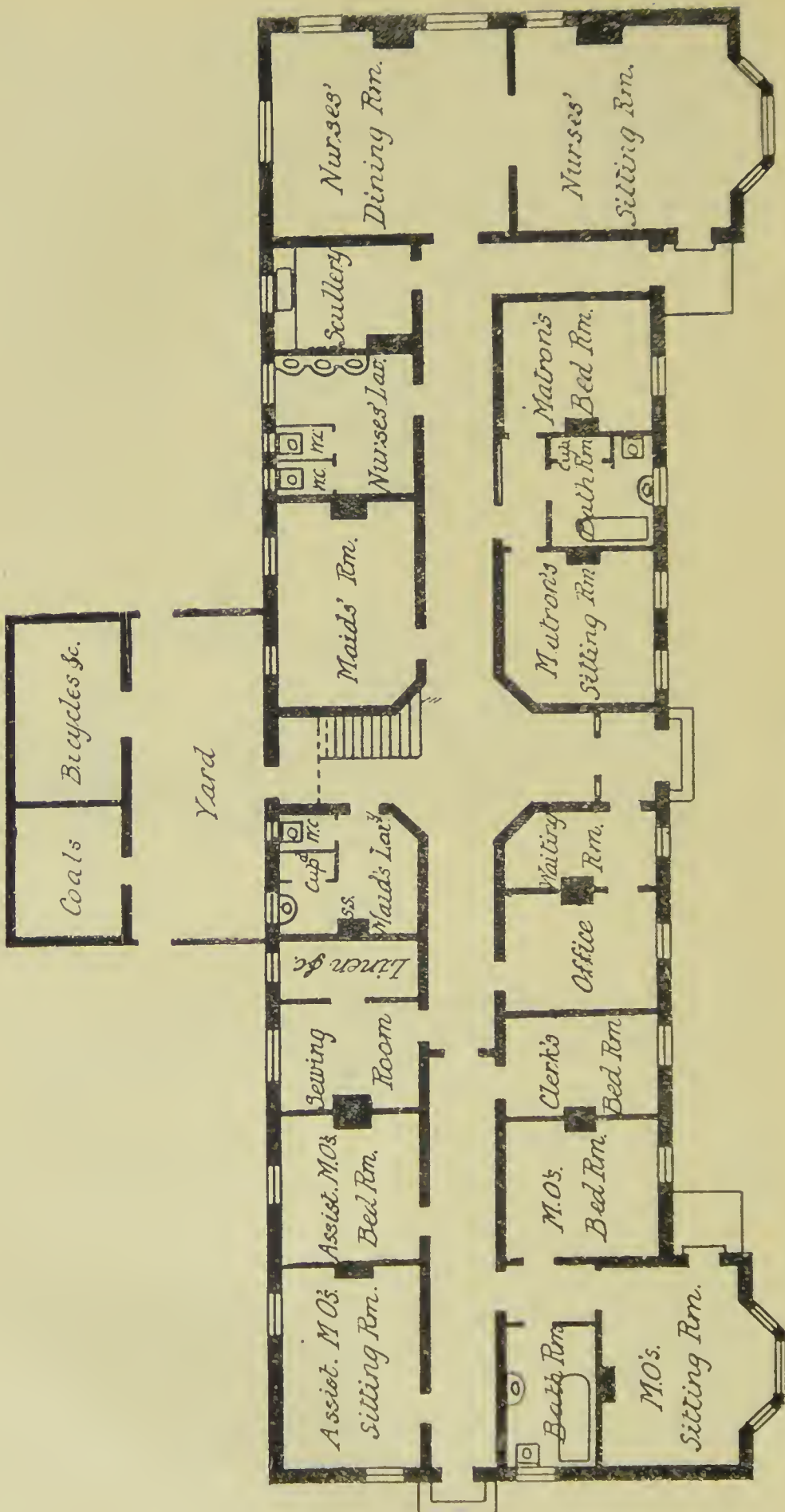
PLAN "B."

Laundry, Boiler House, &c.



Scale, 132 Feet = 1 Inch.

STAFF BLOCK.
PLAN "C."

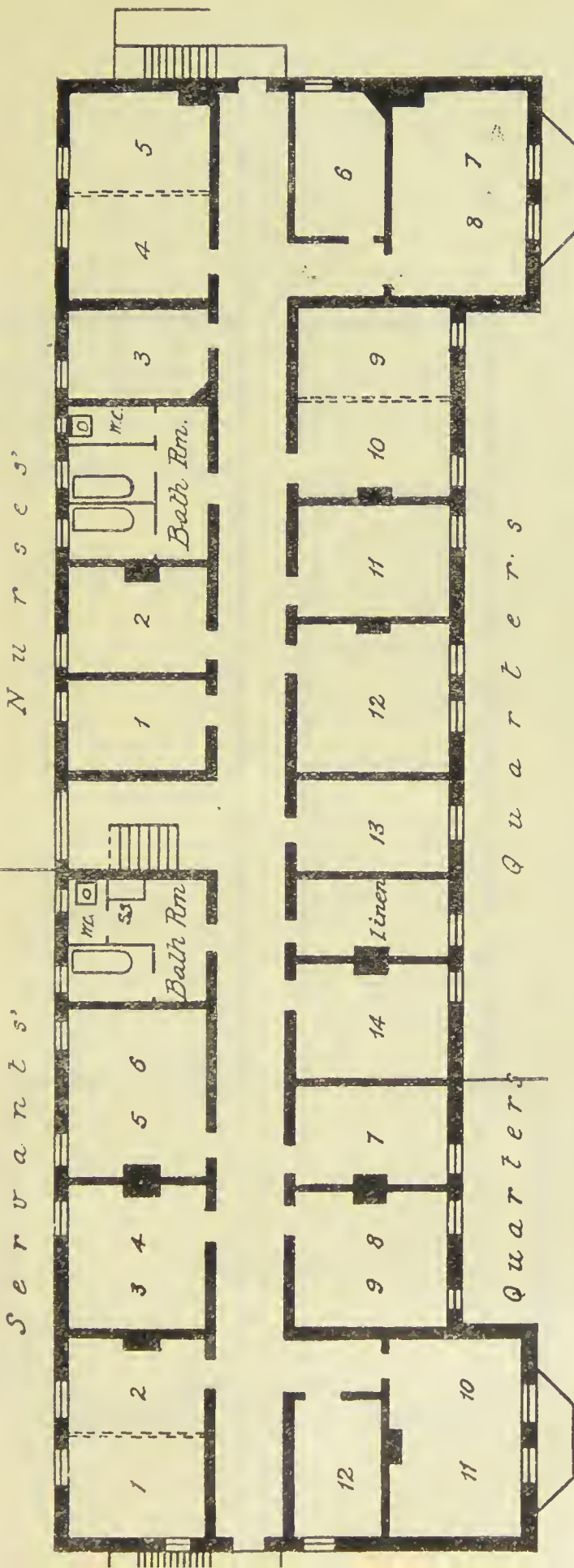


Ground Floor.

Scale, 16 Feet = 1 Inch.

STAFF BLOCK.

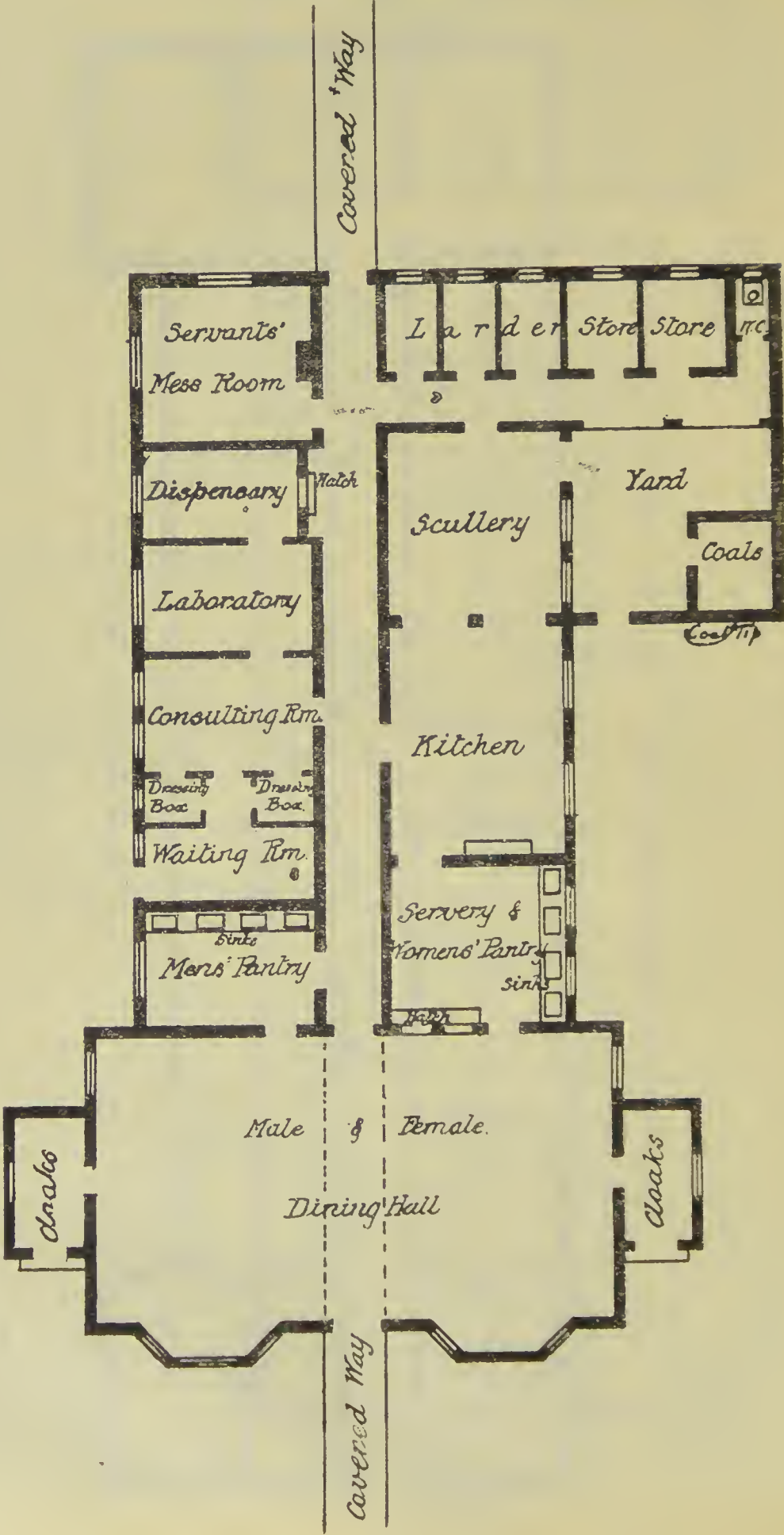
PLAN "D."



First Floor.

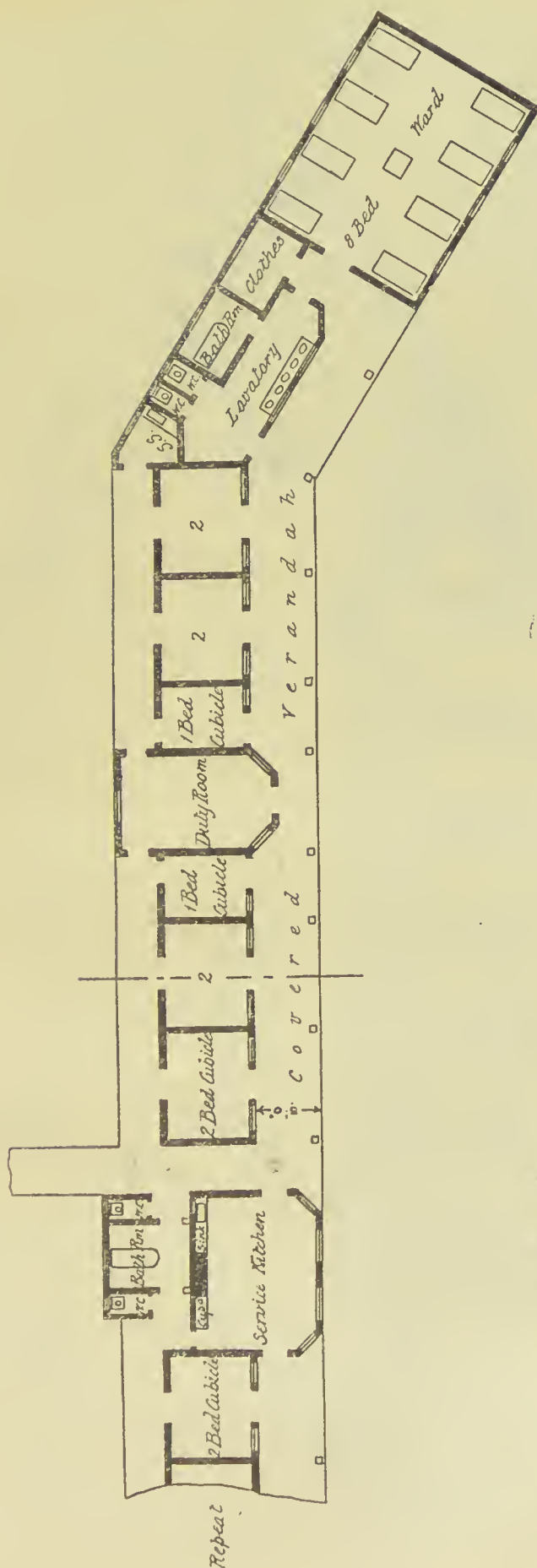
Scale, 16 Feet = 1 Inch.

DINING HALL AND KITCHEN BLOCK.
PLAN "E."



NURSING PAVILION FOR 36 BEDS.—SINGLE STOREY.

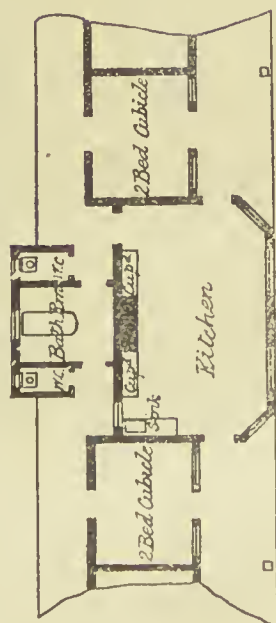
PLAN "F."



Scale 24 Feet = 1 Inch.



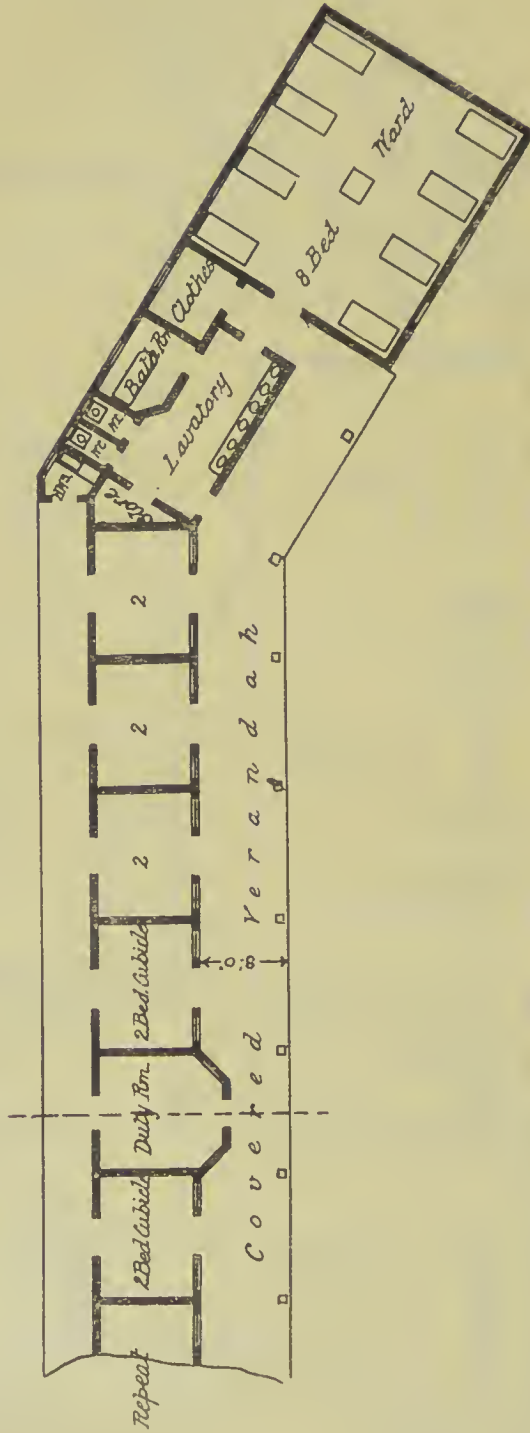
Cross Section



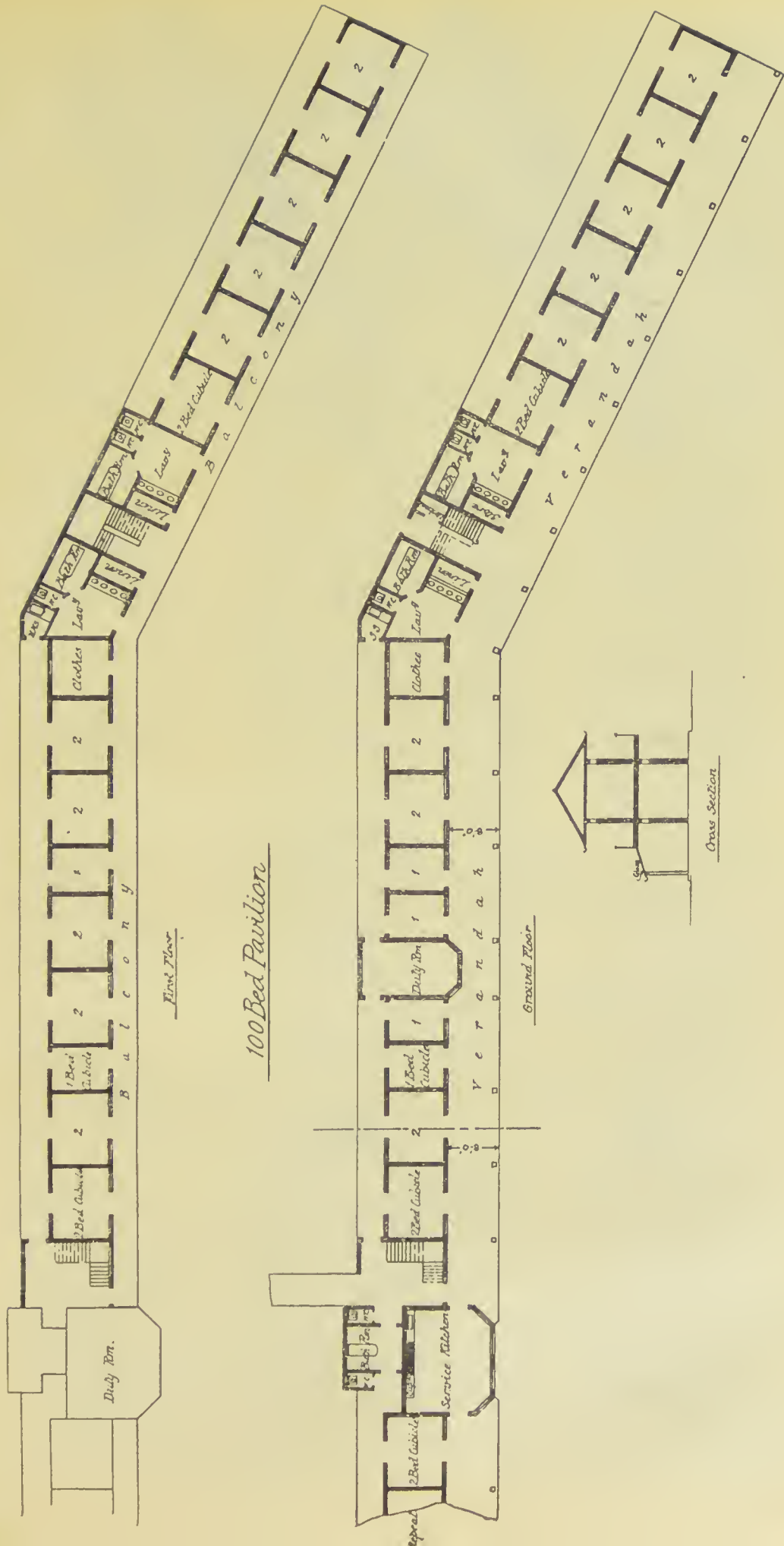
Alternative Plan of Central Portion, where it is not proposed to provide a Central Kitchen Block.

CONVALESCENT PAVILION FOR 32 BEDS.—SINGLE STOREY.

PLAN "G."

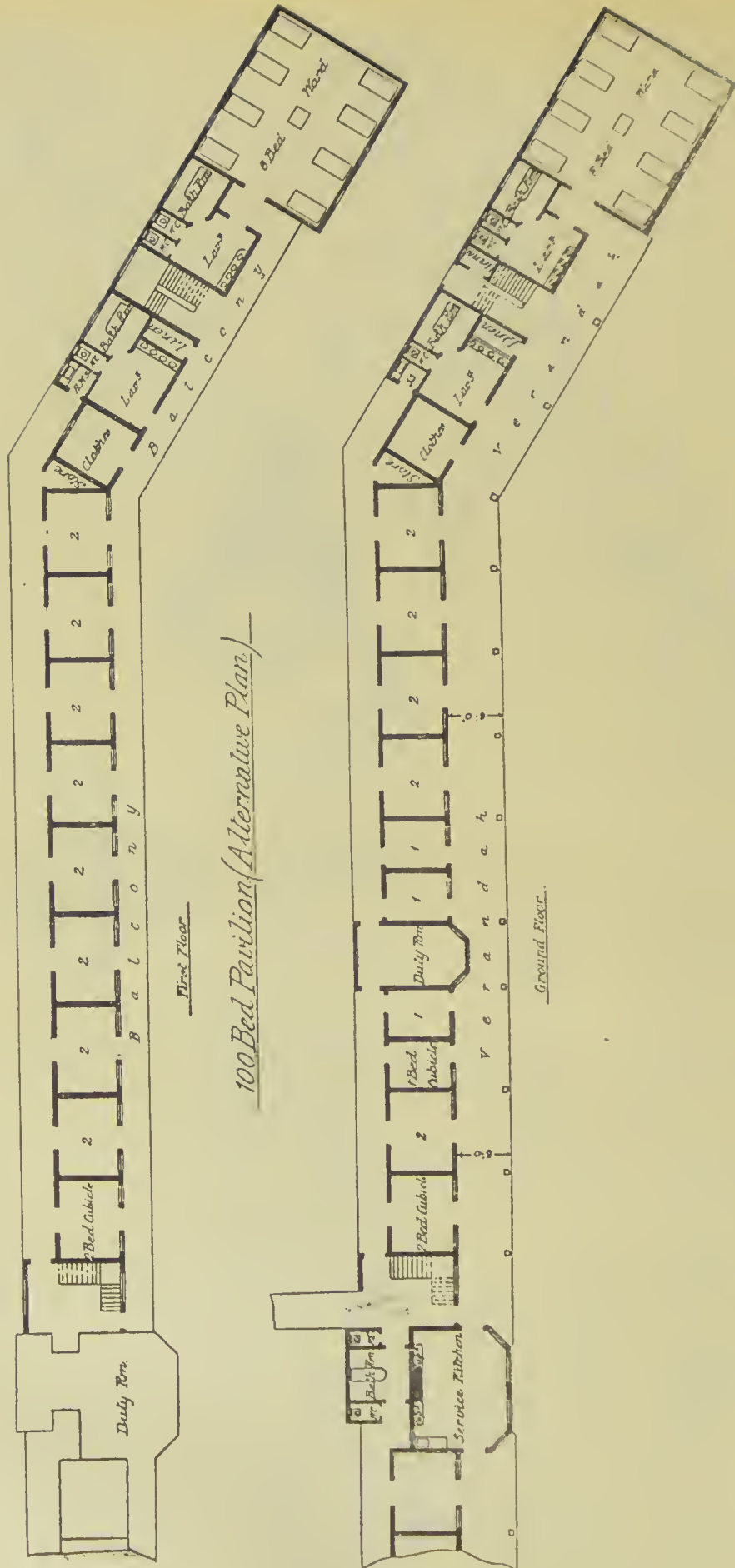


Scale, 24 Feet = 1 Inch.



Scale, 32 Feet = 1 Inch.

PLAN "I."



APPENDIX A., No. 17.

TUBERCULOSIS STATISTICS.

TABLE I.—ADMINISTRATIVE COUNTIES.

Pulmonary Tuberculosis. Death-rates per 1,000 living at all ages, 1911-12.

Males.			Females.		
Names of Administrative Counties.	Standardised Rate.	Crude Rate.	Names of Administrative Counties.	Standardised Rate.	Crude Rate.
Cardiganshire ...	1·94	2·04	Cardiganshire ...	1·90	1·96
Merionethshire ...	1·78	1·92	Anglesey ...	1·54	1·56
Carnarvonshire ...	1·61	1·73	Merionethshire...	1·47	1·50
Cornwall ..	1·54	1·60	Carnarvonshire...	1·41	1·46
Carmarthenshire ...	1·21	1·25	Radnorshire ...	1·20	1·20
Pembrokeshire ...	1·20	1·23	Carmarthenshire ...	1·19	1·18
Northamptonshire ...	1·10	1·15	Huntingdonshire ...	1·09	1·07
Suffolk, West ...	1·08	1·12	Cumberland ...	1·03	1·03
Essex ...	1·02	1·04	Pembrokeshire...	·98	·98
Cambridgeshire ...	1·01	1·07	Glamorganshire ...	·96	·92
Kent ...	1·00	1·04	Durham ...	·95	·91
Lancashire ...	1·00	1·06	Flintshire ...	·95	·95
Nottinghamshire ..	1·00	1·01	Northumberland ...	·95	·94
Cumberland ...	·99	1·01	Isle of Ely ...	·94	·92
Flintshire ...	·99	1·01	Suffolk, West ...	·94	·93
Northumberland ...	·99	1·00	Yorkshire, North Riding	·94	·95
Staffordshire ...	·98	·98	Cornwall ...	·93	·95
Durham ...	·97	·91	Denbighshire ...	·91	·91
Middlesex ...	·97	1·00	Herefordshire ...	·90	·90
Montgomeryshire ...	·97	1·01	Leicestershire ...	·90	·90
Sussex, East ...	·97	1·03	Montgomeryshire ...	·90	·89
Anglesey ...	·96	1·00	Brecknockshire ...	·88	·86
Shropshire ...	·96	1·00	Lincolnshire, parts of	·88	·87
Isle of Ely ...	·95	·99	Lindsey.		
Gloucestershire ...	·95	·98	Devonshire ...	·87	·91
Leicestershire ...	·95	·97	Isle of Wight ...	·87	·92
Isle of Wight ...	·94	1·02	Norfolk ...	·85	·83
Devonshire ...	·93	·99	Yorkshire, East Riding	·85	·86
Bedfordshire ...	·92	·95	Lincolnshire, parts of	·83	·81
Sussex, West ...	·92	·96	Holland.		
Cheshire ...	·91	·96	Staffordshire ...	·82	·79
Wiltshire ...	·90	·94	Northamptonshire ...	·80	·80
Yorkshire, West Riding	·90	·95	Yorkshire, West Riding	·80	·81
Hertfordshire ...	·89	·92	Kent ...	·79	·79
Huntingdonshire ...	·89	·92	Lincolnshire, parts of	·79	·79
Soke of Peterborough ...	·89	·94	Kesteven.		
Surrey ...	·89	·95	Monmouthshire ...	·79	·79
Denbighshire ...	·88	·91	Oxfordshire ...	·79	·79
Southampton ...	·88	·92	Suffolk, East ..	·79	·78
Radnorshire ...	·87	·93	Lancashire ...	·78	·81
Yorkshire, North Riding	·87	·90	Somersetshire ...	·78	·79
Warwickshire ...	·86	·88	Shropshire ...	·76	·75
Worcestershire ...	·86	·88	Bedfordshire ...	·75	·77
Lincolnshire, parts of	·84	·86	Cheshire ...	·73	·76
Holland.			Derbyshire ...	·73	·71
Suffolk, East ...	·82	·83	Soke of Peterborough...	·72	·73
Berkshire... ..	·80	·84	Nottinghamshire ...	·71	·70
Herefordshire ...	·80	·84	Dorsetshire ...	·70	·72
Lincolnshire, parts of	·80	·84	Gloucestershire ...	·70	·71
Kesteven.			Buckinghamshire ...	·69	·70

TABLE I.—*continued.*

Males.			Females.		
Names of Administrative Counties.	Standardised Rate.	Crude Rate.	Names of Administrative Counties.	Standardised Rate.	Crude Rate.
Oxfordshire	·80	·83	Essex	·69	·69
Rutlandshire	·80	·82	Sussex, East	·68	·72
Somersetshire	·79	·82	Sussex, West	·63	·70
Westmoreland	·78	·83	Middlesex	·67	·69
Buckinghamshire	·77	·80	Worcestershire	·66	·66
Brecknockshire	·75	·78	Southampton	·65	·66
Norfolk	·75	·78	Berkshire	·64	·65
Derbyshire	·74	·74	Cambridgeshire	·64	·65
Lincolnshire, parts of	·74	·77	Wiltshire	·63	·63
Lindsey.			Hertfordshire	·62	·64
Yorkshire, East Riding...	·74	·77	Warwickshire	·62	·62
Dorsetshire	·73	·78	Westmorland	·58	·61
Glamorganshire	·72	·73	Surrey	·56	·60
Monmouthshire	·57	·57	Rutlandshire	·55	·55

TABLE II.—ADMINISTRATIVE COUNTIES.

Non-pulmonary Tuberculosis. Death-rates per 1,000 living at all ages, 1911-12.

Carnarvonshire	·65	·58	Radnorshire	·54	·49
Cardiganshire	·63	·54	Cardiganshire	·50	·40
Durham	·59	·61	Carmarthenshire	·49	·49
Anglesey	·63	·49	Carnarvonshire	·49	·43
Pembrokeshire	·53	·49	Lincolnshire, parts of	·47	·46
Denbighshire	·49	·46	Holland.		
Radnorshire	·49	·44	Merionethshire	·47	·40
Nottinghamshire	·48	·48	Durham... ..	·46	·52
Northumberland	·47	·47	Northumberland	·46	·48
Merionethshire	·45	·39	Pembroke	·44	·41
Yorkshire, West Riding	·45	·43	Cornwall	·43	·37
Cheshire	·44	·41	Lancashire	·39	·36
Cumberland	·43	·41	Yorkshire, North Riding	·39	·38
Rutlandshire	·43	·39	Yorkshire, West Riding	·39	·38
Lancashire	·41	·38	Staffordshire	·38	·40
Lincolnshire, parts of	·41	·40	Yorkshire, East Riding	·38	·35
Holland.			Cumberland	·37	·36
Yorkshire, North Riding	·41	·39	Montgomeryshire	·37	·34
Carmarthenshire	·40	·38	Nottinghamshire	·36	·38
Cambridgeshire	·39	·35	Cheshire	·35	·32
Leicestershire	·39	·37	Anglesey	·34	·30
Berkshire	·38	·34	Lincolnshire, parts of	·34	·33
Staffordshire	·37	·38	Lindsey.		
Sussex, East	·36	·32	Isle of Wight	·33	·27
Derby	·35	·35	Cambridgeshire	·32	·28
Lincolnshire, parts of	·35	·33	Leicestershire	·32	·31
Lindsey.			Shropshire	·32	·30
Cornwall... ..	·34	·31	Suffolk, East	·32	·30
Kent	·34	·31	Denbighshire	·31	·30
Montgomeryshire	·34	·31	Derbyshire	·31	·33
Warwickshire	·34	·32	Devonshire	·31	·26
Worcestershire	·34	·32	Berkshire	·30	·27
Northamptonshire	·32	·29	Kent	·30	·27
Isle of Wight	·32	·28	Essex	·29	·28
Glamorganshire... ..	·31	·32	Flintshire	·29	·28
Devonshire	·30	·26	Northamptonshire	·29	·27

TABLE II.—*continued.*

Males.			Females.		
Names of Administrative Counties.	Standardised Rate.	Crude Rate.	Names of Administrative Counties.	Standardised Rate.	Crude Rate.
Essex	·30	·29	Worcestershire... ..	·29	·27
Lincolnshire, parts of Kesteven.	·30	·28	Herefordshire	·29	·26
Middlesex	·30	·30	Sussex, West	·29	·25
Huntingdonshire	·30	·27	Glamorganshire	·28	·32
Southampton	·30	·27	Isle of Ely	·28	·27
Sussex, West	·30	·27	Suffolk, West	·27	·25
Flintshire	·29	·28	Brecknockshire	·26	·27
Wiltshire... ..	·29	·27	Buckinghamshire	·26	·24
Yorkshire, East Riding	·29	·26	Soke of Peterborough	·26	·26
Shropshire	·28	·26	Somersetshire	·26	·23
Dorsetshire	·28	·24	Sussex, East	·26	·22
Brecknockshire	·27	·26	Westmorland	·26	·22
Isle of Ely	·27	·25	Warwickshire	·26	·25
Hertfordshire	·27	·25	Huntingdonshire	·24	·23
Norfolk	·27	·25	Norfolk	·24	·22
Soke of Peterborough ...	·27	·25	Dorsetshire	·24	·21
Herefordshire	·27	·24	Surrey	·24	·21
Suffolk, West	·27	·24	Lincolnshire, parts of Kesteven.	·23	·22
Bedfordshire	·26	·24	Middlesex	·23	·22
Westmorland	·26	·23	Monmouthshire	·23	·27
Buckinghamshire	·25	·23	Berkshire	·23	·21
Gloucestershire	·25	·23	Gloucestershire	·23	·21
Suffolk, East	·25	·22	Hertfordshire	·23	·21
Surrey	·23	·21	Oxfordshire	·21	·19
Monmouthshire... ..	·22	·23	Southampton	·21	·20
Oxfordshire	·22	·20	Wiltshire	·16	·15
Somersetshire	·22	·20	Rutlandshire	11	·10

TABLE III.—COUNTY BOROUGHES.

Pulmonary Tuberculosis. Death-rates per 1,000 living at all ages, 1911-12.

Males.			Females.		
Names of County Boroughs.	Standardised Rate.	Crude Rate.	Names of County Boroughs.	Standardised Rate.	Crude Rate.
Liverpool... ..	2·21	2·23	Tynemouth	1·52	1·50
Salford	2·14	2·20	Bootle	1·49	1·48
Manchester	1·98	2·09	Swansea... ..	1·43	1·44
Burton-upon-Trent	1·87	1·97	Liverpool	1·39	1·40
Southampton	1·84	1·95	Gateshead	1·35	1·31
Swansea	1·71	1·79	Cardiff	1·34	1·35
Bootle	1·67	1·68	South Shields	1·34	1·30
Leeds	1·66	1·77	Devonport	1·28	1·31
Birmingham	1·65	1·71	Sunderland	1·26	1·24
Exeter	1·65	1·76	Merthyr Tydfil... ..	1·25	1·20
Great Yarmouth	1·64	1·67	Burton-on-Trent	1·24	1·25
Sheffield	1·64	1·70	Warrington	1·23	1·19
Northampton	1·63	1·71	St. Helen's	1·21	1·15
Stoke-on-Trent	1·56	1·55	Salford	1·20	1·22
Oldham	1·55	1·70	Stoke-on-Trent... ..	1·19	1·17

TABLE III.—*continued.*

Males.			Females.		
Names of County Boroughs.	Stand- ardised Rate.	Crude Rate.	Names of County Boroughs.	Stand- ardised Rate.	Crude Rate.
Walsall ...	1.55	1.55	Newcastle-on-Tyne ...	1.14	1.15
Eastbourne ...	1.54	1.61	Middlesbrough ...	1.13	1.11
Leicester ...	1.54	1.62	Stockport ...	1.11	1.16
Canterbury ...	1.52	1.59	Chester ...	1.09	1.12
Gateshead ...	1.52	1.50	Manchester ...	1.09	1.13
Ipswich ...	1.52	1.56	Plymouth ...	1.09	1.13
Newcastle-on-Tyne	1.50	1.54	Great Yarmouth ...	1.08	1.10
Preston ...	1.50	1.56	Norwich ...	1.07	1.09
South Shields ..	1.49	1.43	Ipswich ...	1.06	1.08
Hastings ...	1.47	1.59	Leicester ...	1.05	1.09
Warrington ...	1.47	1.45	Wigan ...	1.05	1.04
West Ham ...	1.47	1.44	Bristol ...	1.04	1.07
Nottingham ...	1.46	1.54	Leeds ...	1.03	1.07
Stockport... ..	1.46	1.55	Leeds ...	1.03	1.07
Bournemouth ...	1.45	1.59	Portsmouth ...	1.02	1.06
Tynemouth ...	1.45	1.43	West Bromwich ...	1.01	.97
Worcester ...	1.45	1.50	West Ham ...	1.01	.98
Cardiff ...	1.44	1.50	Birkenhead ...	.99	1.00
Brighton ...	1.42	1.54	Southampton ...	.99	1.01
Sunderland ...	1.38	1.35	Walsall ...	.99	.98
Birkenhead ...	1.36	1.38	Kingston-on-Hull ..	.98	.98
Bradford ...	1.36	1.53	Birmingham ...	.97	1.00
Kingston-on-Hull	1.34	1.36	Exeter ...	.97	1.03
Bristol ...	1.33	1.36	Nottingham ...	.97	1.01
Middlesbrough ...	1.30	1.34	West Hartlepool ...	.96	.94
Gloucester ...	1.28	1.32	Rochdale ...	.95	1.02
Bolton ...	1.27	1.33	Oldham ...	.94	1.00
Bury ...	1.27	1.42	Bradford ...	.93	1.01
Smethwick ...	1.26	1.26	Gloucester ...	.93	.95
Coventry ...	1.25	1.32	Lincoln ...	.92	.96
Norwich ...	1.24	1.28	Northampton ...	.92	.95
Plymouth ...	1.24	1.32	Brighton ...	.90	.96
Wolverhampton...	1.19	1.23	Grimsby... ..	.90	.91
Chester ...	1.17	1.25	Newport (Mon.) ...	.90	.90
Oxford ...	1.17	1.25	Hastings ...	.89	.96
West Hartlepool...	1.16	1.16	Derby ...	.87	.89
Halifax ...	1.15	1.30	Worcester ...	.86	.89
York ...	1.15	1.21	Bury ...	.85	.93
Merthyr Tydfil ...	1.13	1.16	Rotherham ...	.85	.82
Rotherham ...	1.13	1.15	Bournemouth ...	.84	.95
Croydon ...	1.11	1.15	Burnley ...	.84	.90
Southport ...	1.11	1.21	Preston ...	.84	.88
Blackpool ...	1.10	1.24	Canterbury ...	.83	.85
Newport (Mon.)...	1.10	1.14	Bolton ...	.82	.86
Portsmouth ...	1.10	1.17	Sheffield ...	.82	.82
Derby ...	1.09	1.16	Smethwick ...	.81	.80
Bath ...	1.07	1.13	Barrow-in-Furness ...	.80	.80
Reading ...	1.07	1.14	Reading... ..	.78	.80
Lincoln ...	1.05	1.16	Halifax ...	.74	.80
West Bromwich...	1.05	1.03	Wolverhampton ...	.74	.74
St. Helen's ...	1.04	1.02	York ...	.74	.76
Blackburn ...	1.03	1.11	Bath ...	.73	.78
Rochdale ...	1.03	1.14	Coventry ...	.72	.73
Burnley ...	1.01	1.09	Croydon... ..	.72	.75
Barrow-in-Furness	1.00	1.04	Oxford ...	.72	.77
Wigan ...	.99	.99	Blackburn ...	.71	.76
Huddersfield ...	.98	1.10	Blackpool ...	.71	.78
Devonport ...	.72	.77	Eastbourne ...	.62	.69
Grimsby ...	.67	.71	Huddersfield ...	.62	.67
Dudley ...	.54	.54	Southport ...	.60	.67
			Dudley ...	.52	.50

TABLE IV.—COUNTY BOROUGHES.

Non-pulmonary Tuberculosis. Death-rates per 1,000 living at all ages, 1911-12.

Males.			Females.		
Names of County Boroughs.	Standardised Rate.	Crude Rate.	Names of County Boroughs.	Standardised Rate.	Crude Rate.
West Hartlepool ...	·88	·91	Huddersfield ...	·68	·39
Middlesbrough ...	·69	·70	West Hartlepool ...	·67	·71
Tynemouth ...	·69	·72	Wigan ...	·65	·67
Salford ...	·66	·67	Salford ...	·59	·59
Stoke-on-Trent ...	·62	·65	Bury ...	·56	·47
Leeds ...	·61	·57	Canterbury ...	·55	·50
Sunderland ...	·61	·65	Tynemouth ...	·55	·57
Manchester ...	·57	·56	Newcastle-on-Tyne ...	·54	·55
Preston ...	·57	·55	Warrington ...	·54	·59
Rochdale... ..	·57	·51	Middlesbrough ...	·53	·58
St. Helens ...	·57	·61	Norwich ...	·52	·47
Wigan ...	·57	·58	St. Helens ...	·50	·58
Derby ...	·56	·53	Preston ...	·49	·45
Newcastle-on-Tyne ...	·55	·54	Sunderland ...	·49	·51
Walsall ...	·55	·56	York ...	·48	·45
Birkenhead ...	·54	·55	Manchester ...	·47	·45
Chester ...	·52	·49	Leeds ...	·47	·44
Gateshead ...	·52	·54	Rochdale ...	·47	·41
Gloucester ...	·52	·48	Smethwick ...	·47	·49
Halifax ...	·52	·44	Stoke-on-Trent ...	·47	·50
Stockport ...	·52	·50	South Shields ...	·44	·48
Burnley ...	·51	·48	Burnley... ..	·43	·39
Warrington ...	·51	·53	Hastings ...	·43	·31
Bury ...	·50	·43	Rotherham ...	·43	·48
South Shields ...	·50	·54	Stockport ...	·43	·39
Exeter ...	·49	·44	Devonport ...	·42	·41
Rotherham ...	·49	·51	Grimsby ...	·42	·43
Canterbury ...	·48	·43	Brighton ...	·41	·33
Leicester... ..	·48	·45	Halifax ...	·41	·33
Southampton ...	·48	·46	Newport (Mon.) ...	·41	·43
Brighton ...	·47	·40	Portsmouth ...	·41	·40
Grimsby ...	·47	·46	Derby ...	·40	·38
Liverpool ...	·47	·49	Dudley ...	·40	·42
Plymouth ...	·47	·44	Gateshead ...	·40	·33
Cardiff ...	·46	·44	Great Yarmouth ...	·40	·36
Huddersfield ...	·46	·41	Birkenhead ...	·39	·40
Norwich ...	·46	·44	Bootle ...	·39	·40
Oldham ...	·46	·43	Kingston-on-Hull ...	·39	·40
Sheffield ...	·46	·46	Liverpool ...	·39	·40
Wolverhampton... ..	·46	·44	Nottingham ...	·39	·36
York ...	·46	·44	Southampton ...	·39	·37
Great Yarmouth ...	·45	·45	West Bromwich ...	·39	·43
Hastings ...	·45	·38	Worcester ...	·39	·35
Bournemouth ...	·44	·39	Leicester ...	·38	·35
Burton-upon-Trent ...	·44	·41	Walsall ...	·38	·40
Nottingham ...	·43	·41	Bradford ...	·37	·30
Dudley ...	·42	·42	Bolton ...	·36	·33
Barrow-in-Furness ...	·40	·39	Exeter ...	·36	·30
West Ham ...	·40	·43	Lincoln ...	·35	·33
Blackpool ...	·39	·33	Oldham ...	·34	·31
Smethwick ...	·39	·39	West Ham ...	·34	·37
Swansea ...	·39	·38	Ipswich ...	·33	·31
Bradford ...	·38	·33	Merthyr Tydfil ...	·33	·38
Ipswich ...	·38	·37	Wolverhampton ...	·33	·32
Croydon ...	·37	·36	Plymouth ...	·32	·28
Kingston-on-Hull ...	·37	·38	Reading... ..	·32	·29
Portsmouth ...	·37	·35	Oxford ...	·31	·26

TABLE IV.—*continued.*

Males.			Females.		
Names of County Boroughs.	Standardised Rate.	Crude Rate.	Names of County Boroughs.	Standardised Rate.	Crude Rate
Devonport	·36	·31	Sheffield	·31	·32
Lincoln	·36	·33	Southport	·31	·23
Bolton	·35	·33	Croydon	·30	·27
West Bromwich	·35	·36	Blackburn	·29	·25
Blackburn	·34	·31	Cardiff	·29	·29
Bristol	·34	·33	Chester	·29	·27
Southport	·34	·31	Northampton	·29	·26
Newport (Mon.)	·33	·33	Swansea	·29	·30
Merthyr Tydfil	·32	·33	Blackpool	·28	·22
Northampton	·32	·29	Burton-upon-Trent	·28	·27
Coventry... ..	·31	·30	Coventry	·28	·23
Reading	·31	·29	Bristol	·27	·24
Worcester	·31	·29	Gloucester	·27	·25
Birmingham	·30	·30	Birmingham	·24	·23
Bootle	·28	·29	Barrow-in-Furness	·22	·23
Oxford	·26	·23	Eastbourne	·19	·14
Eastbourne	·20	·18	Bournemouth	·18	·13
Bath	·19	·17	Bath	·13	·10

TABLE V.—METROPOLITAN BOROUGHES.

Pulmonary Tuberculosis. Death-rates per 1,000 living at all ages, 1911-12.

Males.			Females.		
Names of Metropolitan Boroughs.	Standardised Rate.	Crude Rate.	Names of Metropolitan Boroughs.	Standardised Rate.	Crude Rate.
Shoreditch	2·64	2·62	Southwark	1·43	1·43
Holborn	2·61	3·16	Bermondsey	1·42	1·38
Finsbury	2·40	2·47	Shoreditch	1·42	1·38
Bethnal Green	2·36	2·28	Finsbury	1·36	1·35
Stepney	2·22	2·19	Stepney	1·35	1·31
Bermondsey	2·17	2·19	Poplar	1·17	1·13
Southwark	2·15	2·26	Bethnal Green	1·15	1·12
London, City of	2·12	2·70	Camberwell	1·10	1·12
Chelsea	1·94	2·18	Fulham	1·09	1·13
St. Pancras	1·90	2·10	St. Pancras	1·07	1·13
St. Marylebone	1·86	2·16	Hammersmith	1·03	1·08
Poplar	1·80	1·80	Battersea	1·02	1·04
Lambeth	1·79	1·93	Hackney	1·02	1·06
Fulham	1·76	1·84	Deptford	1·01	1·03
Hackney	1·73	1·82	Holborn	1·01	1·14
Greenwich	1·68	1·69	Islington	0·99	1·04
Deptford	1·61	1·68	Lambeth	0·94	0·98
Camberwell	1·60	1·65	Greenwich	0·93	0·94
Westminster	1·53	1·89	Woolwich	0·86	0·87
Islington	1·52	1·63	St. Marylebone... ..	0·78	0·90
Hammersmith	1·50	1·63	Stoke Newington	0·75	0·82
Battersea	1·49	1·55	London, City of	0·74	0·86
Woolwich	1·49	1·56	Chelsea	0·72	0·82
Kensington	1·36	1·52	Paddington	0·71	0·80
Paddington	1·31	1·47	Wandsworth	0·70	0·74
Stoke Newington	1·18	1·32	Kensington	0·63	0·73
Wandsworth	1·14	1·22	Westminster	0·60	0·71
Hampstead	0·94	1·09	Lewisham	0·55	0·58
Lewisham	0·81	0·85	Hampstead	0·38	0·45

TABLE VI.—METROPOLITAN BOROUGHES.

Non-pulmonary Tuberculosis. Death-rates per 1,000 living at all ages, 1911-12.

Males.			Females.		
Names of Metropolitan Boroughs.	Standardised Rate.	Crude Rate.	Names of Metropolitan Boroughs.	Standardised Rate.	Crude Rate.
London, City of ...	0·72	0·46	Bermondsey ...	0·59	0·64
Bermondsey ...	0·63	0·65	London, City of ...	0·54	0·37
Finsbury ...	0·60	0·59	Shoreditch ...	0·52	0·56
Holborn ...	0·60	0·46	Bethnal Green ...	0·50	0·54
Shoreditch ...	0·58	0·60	Finsbury ...	0·48	0·48
Bethnal Green ...	0·57	0·61	Poplar ...	0·39	0·42
Southwark ...	0·53	0·53	Stepney ...	0·38	0·41
St. Marylebone ...	0·49	0·41	Chelsea ...	0·37	0·28
Chelsea ...	0·48	0·43	St. Pancras ...	0·36	0·33
Islington ...	0·47	0·45	Woolwich ...	0·36	0·35
Stoke Newington ...	0·45	0·40	Greenwich ...	0·35	0·35
Deptford ...	0·44	0·44	Hackney ...	0·34	0·31
St. Pancras ...	0·44	0·40	Islington ...	0·34	0·31
Stepney ...	0·44	0·47	Deptford ...	0·33	0·33
Woolwich ...	0·44	0·42	Southwark ...	0·33	0·34
Greenwich ...	0·43	0·42	Camberwell ...	0·32	0·31
Hackney ...	0·43	0·41	Hammersmith ...	0·32	0·29
Kensington ...	0·42	0·37	Fulham ...	0·31	0·30
Lambeth ...	0·41	0·38	Holborn ...	0·30	0·24
Hampstead ...	0·40	0·33	Lambeth ...	0·30	0·27
Paddington ...	0·40	0·36	St. Marylebone... ..	0·30	0·22
Westminster ...	0·40	0·28	Battersea ...	0·29	0·28
Hammersmith ...	0·39	0·37	Westminster ...	0·29	0·20
Camberwell ...	0·36	0·35	Stoke Newington ...	0·26	0·21
Poplar ...	0·36	0·38	Kensington ...	0·24	0·17
Wandsworth ...	0·35	0·34	Lewisham ...	0·24	0·21
Battersea ...	0·33	0·33	Paddington ...	0·24	0·19
Fulham ...	0·30	0·31	Wandsworth ...	0·21	0·19
Lewisham ...	0·23	0·22	Hampstead ...	0·09	0·06

TABLE VII.—LIST OF STANDARDISING FACTORS ALTERED BY REASON OF CHANGES IN BOUNDARY.

(See pages 240–243 of last Annual Report.)

Date of Change.	Area.	Males.			Females.			Persons.		
		Phthisis.	Other Tuberculosis.	All Tuberculosis.	Phthisis.	Other Tuberculosis.	All Tuberculosis.	Phthisis.	Other Tuberculosis.	All Tuberculosis.
<i>County Boroughs.</i>										
9th November, 1911	Bath ...	·9502	1·1211	·9939	·9416	1·2873	1·0318	·9658	1·2169	1·0308
"	Birmingham ...	·9671	1·0091	·9788	·9742	1·0305	·9918	·9724	1·0203	·9866
"	Reading ...	·9425	1·0713	·9763	·9725	1·1003	1·0107	·9566	1·0855	·9926
1st April, 1912	Sheffield ...	·9644	·9929	·9725	·9967	·9692	·9876	·9745	·9801	·9762
"	Southport ...	·9205	1·1452	·9758	·9026	1·3313	1·0084	·9348	1·2562	1·0140
<i>Administrative Counties.</i>										
9th November, 1911	Berkshire ...	·9544	1·1077	·9941	·9829	1·1074	1·0202	·9648	1·1066	1·0041
"	Oxfordshire ...	·9642	1·1032	1·0006	1·0060	1·0936	1·0328	·9791	1·0971	1·0124
"	Somersetshire ...	·9658	1·1041	1·0021	·9811	1·1399	1·0277	·9763	1·1231	1·0169
"	Staffordshire ...	1·0040	·9868	·9989	1·0331	·9445	1·0025	1·0094	·9638	·9948
"	Warwickshire ...	·9725	1·0497	·9936	·9927	1·0478	1·0099	·9796	1·0480	·9995
"	Worcestershire ...	·9757	1·0605	·9988	·9969	1·0646	1·0180	·9855	1·0628	1·0079
1st April, 1912	Lancashire ...	·9419	1·0713	·9759	·9588	1·0790	·9948	·9498	1·0753	·9849
"	Yorkshire, West Riding ...	·9502	1·0419	·9750	·9838	1·0210	·9955	·9610	1·0303	·9811
Correction	Wiltshire ...	·9562	1·0882	—	—	—	—	—	—	—

The corrected factors given in this table have been used in calculating the rates shown in Tables I. IV. of this Appendix.

APPENDIX B., No. 1.

SECOND REPORT ON ARTERIAL DEGENERATION ; by
F. W. ANDREWES, M.D., F.R.C.P., D.P.H.

Two years ago I submitted to the Board a report on this subject in which I endeavoured to present a general review of our present knowledge on arterial degeneration and its causes. That report did not contain the results of any special investigation carried out by myself although it embodied a good deal of general work on the subject. The study suggested certain lines of research which I believed might be undertaken with advantage, and during the past two years the Board have instructed me to carry out work on the lines suggested.

The first line of investigation concerned the degree to which *infective conditions* played a part in the premature occurrence of arterial degenerations. It was known that syphilis was thus concerned in a relatively large number of cases : it was believed that typhoid fever and rheumatism produced definite, if slighter, changes in the arterial wall, which might be the starting points of later degenerative changes. It therefore seemed worth while to study the question of these and other infective conditions in more detail as regards their influence upon the arteries.

The second line of investigation was of an entirely different kind. In all studies of this nature the need is at once felt for some definite criterion, if possible a numerical one, by which the degree of degeneration can be approximately judged. Given such a criterion, it becomes possible to estimate the degree to which the various causes supposed to produce arterio-sclerosis have been operative. It is difficult to *measure* histological changes : chemical changes on the other hand can be numerically expressed. It appeared therefore worth while to study some selected chemical change in the arterial wall, in order to see whether it might be possible to establish any definite standard by which degenerative changes in the arterial wall could be measured. Two such changes at once suggest themselves—the *fatty* and the *calcareous*. It was the latter of these which seemed to offer the best prospect of success, and which I was instructed by the Board to investigate, though I hope later to have opportunity for studying fatty changes on similar lines.

The present report falls therefore into two distinct parts, each of which represents the result of a year's investigation.

PART I.

The INFLUENCE of INFECTIVE CONDITIONS in DETERMINING
DEGENERATION of the ARTERIAL WALL.*Introduction.*

In my former report I pointed out that, apart from the well-established effect of syphilis in producing grave disease of the arterial wall, there was evidence that other general infections may induce somewhat similar though less severe changes, and by the same route, namely by the *vasa vasorum*. The evidence has been partly clinical

and partly histological and the observations have been for the most part carried out only in one or two diseases, such as typhoid fever and acute rheumatism.

It is plain that if acute and chronic general infections cause, even as an occasional sequel, permanent damage to the wall of the large arteries, the fact may be of considerable importance in determining the occurrence of premature arterial degeneration. It is probable that there is no other infection comparable to syphilis in the extent of the damage inflicted, or the fact would long ago have been established on clinical grounds. But even minute foci of damage may well play a part in the degenerative process, and may perhaps serve to determine the distribution of the focal lesions of nodular sclerosis when some more general cause of arterial strain comes into play. This conception underlay Thoma's hypothesis of arteriosclerosis, and he expressly claimed that evidence of damage to the middle coat could be found opposite the intimal thickenings of nodular sclerosis.

In approaching this subject I have pursued two lines of investigation :—

- (1) I have endeavoured to ascertain by direct cultural methods whether the arterial wall is actually invaded by bacteria in general infective processes. I am unaware that this method of investigation has hitherto been attempted.
- (2) I have pursued the ordinary methods of histological investigation for determining the presence of inflammatory foci in the arterial wall in patients suffering from recent or past infections.

My material has all been derived from the post-mortem room of St. Bartholomew's Hospital, and I have been at pains to avoid selection as far as possible, investigating every kind of general infection which chanced to present itself. In this way I hoped to obtain an idea of the frequency with which infection was demonstrable in the arterial wall, and of the extent to which such infection was followed by anatomical changes. My observations have almost been confined to the aorta for it is the only vessel large enough for the purpose, and is the one already known to be particularly liable to infective changes in syphilis, rheumatism, &c., probably because its system of vasa vasorum is the best developed. Where possible I have selected the arch of the aorta for cultures and sections, as best suited for my purpose.

(1) CULTURAL INVESTIGATION OF THE AORTA IN INFECTIVE CONDITIONS.

Methods Adopted.

Fallacies are obviously liable to be present in any attempt to cultivate bacteria from a relatively thin structure, such as an artery, under the conditions of an ordinary post-mortem room. My first task was to determine whether it was possible to attain results of any value from material which had been handled and probably subjected to superficial contamination. Fortunately for my purpose, the bodies of those dying at St. Bartholomew's Hospital are at once placed in a cold chamber, and in some 70 per cent. of all cases the heart blood is sterile on post-mortem culture. This circumstance has largely contributed to the possibility of obtaining reliable results.

I at first attempted immersion of the cleansed aorta in strong mercuric chloride solution with subsequent neutralization in sterile ammonium sulphide, but this method appeared too drastic for such a thin structure as the aortic wall, which is probably penetrable to disinfectants. The method finally adopted was as follows:—The aorta was washed in sterile warm water to remove as much surface contamination as possible. The intima was then seared at a selected spot with a heated glass rod. Through the seared surface a cataract knife, recently heated to redness, was obliquely introduced into the substance of the middle coat and rotated, thus stirring up the tissue in several directions. The knife being withdrawn, a strong platinum loop was passed into the aperture, rotated in the disintegrated middle coat, and then rubbed over the surface of an agar slope; three introductions of the wire, thus carried out, were used for each culture.

The reliability of this technique was first tested upon the aortas of persons struck down by violent death while in full health. The following seven cases presented normal or approximately normal aortas:—

- | | | |
|---------------|----------------------|--------------------------|
| 1. Male ... | ... age 51 ... | ... fractured spine. |
| 2. Male ... | ... age doubtful ... | ... fractured spine. |
| 3. Male ... | ... age 37 ... | ... suicide by hanging. |
| 4. Male ... | ... age 35 ... | ... fractured skull. |
| 5. Female ... | ... age 43 ... | ... laceration of brain. |
| 6. Male ... | ... age 58 ... | ... fractured skull. |
| 7. Male ... | ... age 30 ... | ... lift accident. |

In none of these cases did any growth occur in the agar cultures.

I further examined four similar cases in which the aorta presented well-marked sclerotic changes:—

- | | | |
|---------------|----------------|-------------------------------|
| 8. Male ... | ... age 52 ... | ... cerebral hæmorrhage. |
| 9. Female ... | ... age 68 ... | ... run over in street. |
| 10. Male ... | ... age 62 ... | ... run over by train. |
| 11. Male ... | ... age 59 .. | ... severe surgical injuries. |

Of these, the first three yielded sterile cultures from the aorta. No. 11 yielded two colonies—one of *Staphylococcus epidermidis albus*, and one of *Streptococcus salivarius*.

Two further cases were examined:—

- | | | |
|----------------|----------------|--------------------|
| 12. Male ... | ... age 42 ... | ... uræmia. |
| 13. Female ... | ... age 18 ... | ... diabetic coma. |

Both these aortas were sterile on culture.

From these observations I drew the following conclusions: (1) that the technique used was, on the whole, adequate to guard against chance post-mortem room contamination; (2) that, with this technique, the middle coat of the aorta proves habitually sterile in healthy persons. It is commonly taught that this is the case with all healthy tissues, but Conradi has shown that by the employment of a special technique it is possible to demonstrate the presence of bacteria in a considerable percentage of specimens of normal organs taken from healthy animals in the slaughter-house. The species which he found were almost entirely bacteria normally present as saprophytes in the intestine or on the surfaces of the body, and the conclusion which may be accepted from his results is that such saprophytes frequently gain access to the blood stream in small numbers, speedily to perish so long as the resistance to infection is normal. Such considerations probably explain the fact that in one out of 13 cases of death by accident, or by non-infective disease, I got a positive result

from the aorta; the organisms obtained were amongst the commonest saprophytes of the body. It may be noted that the aorta from which I obtained the positive result was not a normal one.

Before leaving the subject of technique I may add that in introducing a cataract knife or platinum wire into a relatively thin structure such as the aorta, it is difficult to be sure where one has really gone. I cannot guarantee that I never transgressed the middle coat, though I did my best to limit myself to it. I never came out on the other side through the adventitia and I sometimes obtained later evidence that I had done what I wished, for in some cases, in subsequently cutting sections for histological examination, the section inadvertently included the needle-track, which was in all such cases found limited to the middle coat.

With this preface as to the method employed, I may pass to the cultural results obtained in various infective conditions. Thirty-six cases in all were cultivated, in most cases from the aortic arch. They were taken, as I have already said, almost without selection, as they presented themselves in the dead-house, but I group them here for convenience in discussion.

A.—*Streptococcal Septicæmias.*

Six cases of acute streptococcal septicæmia were examined by culture of the aorta. In all, the blood infection was due to *streptococcus pyogenes*. The results are shown in tabular form, thus:—

TABLE OF CASES OF STREPTOCOCCAL SEPTICÆMIA.

Case.	Sex.	Age.	Disease.	Result of culture from aorta.
1	Female	50	Carbuncle, followed by streptococcal septicæmia.	Negative.
2	Male	9	Diphtheria, followed by streptococcal septicæmia.	Several colonies of streptococcus pyogenes.
3	Female	19 mths.	Septicæmia starting in a gangrenous tonsil.	A few colonies of streptococcus pyogenes.
4	Female	34	Septicæmia starting in a septic pharyngitis.	A few colonies of streptococcus pyogenes.
5	Male	40	Septicæmia from a poisoned hand. Early syphilitic aortitis.	About 200 colonies of streptococcus pyogenes.
6	Male	48	Cellulitis of calf, with septicæmia.	One colony of staphylococcus epidermidis albus and two colonies of streptococcus salivarius.

In all the above cases the streptococcus, when isolated from the aortic wall, was submitted to routine fermentation tests. In four out of the five positive results it proved identical with that present in the heart blood. In case 6, although the heart blood contained abundant streptococcus pyogenes, the streptococcus from the aortic wall was of a different type. Case 5 was noteworthy from the extreme abundance of the organisms in the aortic wall, so that they were readily demonstrable in stained sections. This is the only case in which I have found any bacterium really abundant in the vessel wall. In other cases only a few colonies were obtained. Case 5 in the above series also presented an early syphilitic mesaortitis to which I shall refer in a later part of this report; it was clearly independent of the acute streptococcal infection.

B.—*Staphylococcal Septicæmias.*

I cultivated the aortic wall in three cases, with the following result :—

TABLE OF CASES OF STAPHYLOCOCCAL SEPTICÆMIA.

Case.	Sex.	Age.	Disease.	Result of culture from aorta.
1	Male	21	Pyæmic abscesses of lung.	Four colonies of staphylococcus aureus, with one or two adventitious contaminations.
2	Female	10	Staphylococcal pericarditis.	Seven colonies of a pale yellow staphylococcus differing in some ways from staphylococcus aureus.
3	Female	23	Carbuncle, with staphylococcal septicæmia.	Negative.

The only case which requires comment here is No. 2. The organism present in the pericardium and blood was ordinary staphylococcus pyogenes aureus. That recovered in pure culture from the aortic wall was paler in colour, took a week or 10 days to ferment mannite, and did not liquefy gelatin. I cannot therefore affirm that it was identical with the organism from the blood.

C.—*Malignant Endocarditis.*

Cultures were taken from the aortic wall in seven cases, as follows :—

TABLE OF CASES OF MALIGNANT ENDOCARDITIS.

Case.	Sex.	Age.	Disease.	Result of culture from aorta.
1	Male	42	Acute streptococcal endocarditis...	Negative.
2	Female	22	Acute puerperal endocarditis due to streptococcus salivarius.	Negative.
3	Female	12	Acute streptococcal endocarditis...	Negative.
4	Female	16	Chronic valvular disease, with terminal malignant endocarditis.	Negative.
5	Male	32	Chronic valvular disease, with terminal malignant endocarditis.	Three colonies of two different species of minute bacillus. Neither determinable.
6	Male	47	Gonococcal endocarditis	Negative.
7	Male	41	Acute streptococcal endocarditis...	Negative.

All the cases in this table were acute vegetative endocarditis, with soft friable vegetations. In none had the disease attacked the intima of the aorta. In No. 5, the only positive result, the organisms obtained bore no relation to that concerned in the valvular infection and were presumably of adventitious origin. Nos. 6 and 7 should perhaps have been excluded from the series, as the technique used was placing the artery in mercuric chloride solution and then neutralizing with ammonium sulphide: I cannot be sure that the disinfectant did not penetrate too deeply.

D.—*Rheumatic Fever and other forms of Endocarditis.*
The following five cases come under this heading:—

TABLE OF CASES OF RHEUMATIC AND OTHER FORMS OF
ENDOCARDITIS.

Case.	Sex.	Age.	Disease.	Result of culture from aorta.
1	Male	14	Rheumatic valvular disease: no recent endocarditis.	Negative.
2	Female	12	Rheumatic fever: recent endocarditis.	Negative.
3	Female	18	Fatal hemichorea: recent endocarditis.	Five colonies of streptococci—streptococcus salivarius and streptococcus faecalis.
4	Female	15	Mitral stenosis: history of scarlet fever.	Negative, except for one or two colonies—obvious contaminations.
5	Female	4	Acute endocarditis in measles	Negative.

E.—*Acute Pneumonia and Acute Peritonitis.*

Three cases of acute pneumonia, or its complications, were studied, and two of acute general peritonitis.

TABLE OF CASES OF PNEUMONIA AND PERITONITIS.

Case.	Sex.	Age.	Disease.	Result of culture from aorta.
1	Male	40	Lobar pneumonia: early syphilitic mesaortitis.	Negative.
2	Male	52	Lobar pneumonia	Negative.
3	Female	9	Pneumonia: meningitis	Negative.
4	Female	22	Appendicitis: general peritonitis ...	Negative.
5	Female	13	Appendicitis: general peritonitis ...	Negative.

F.—*Infections with Bacillus Coli and its Allies.*

Five cases were examined, all of infections of the urinary tract:—

TABLE OF CASES OF INFECTION OF THE URINARY TRACT WITH
B. COLI AND ITS ALLIES.

Case.	Sex.	Age.	Disease.	Result of culture from aorta.
1	Female	47	Calculous pyonephrosis with coli bacilluria.	Negative.
2	Female	66	Accidental damage to ureters in hysterectomy for cancer. General infection with coliform bacilli.	Four colonies in culture—one of B. coli, one of B. lactis aërogenes, one of streptococcus salivarius and one of a small bacillus undetermined.
3	Male	50	Urethral stricture: pyelonephritis.	B. coli communis and streptococcus salivarius.
4	Female	50	Calculous pyelonephritis: coli bacilluria.	Aorta yielded seven colonies—B. lactis aërogenes, B. alkali-genes faecalis and staphylococcus aureus. The innominate artery yielded B. coli communis.
5	Male	72	Enlarged prostate: ascending pyelonephritis: coli bacilluria.	B. coli communis and staphylococcus aureus.

The five preceding cases were primary infections of the urinary tract with members of the *B. coli* group. In cases 1 and 3 the heart blood was sterile after death : in cases 2 and 5 the heart blood yielded coliform bacilli, *i.e.*, there was evidence of general infection, if only terminal : in case 4 the blood could not be cultivated as the autopsy was a limited one.

G.—Other acute infections.

Five cases were cultivated which do not fall into any of the preceding groups.

TABLE OF MISCELLANEOUS CASES OF INFECTION.

Case.	Sex.	Age.	Disease.	Result of culture from aorta.
1	Female	29	Typhoid fever: early pneumonia.	Several colonies of streptococcus salivarius.
2	Female	4	Paratyphoid fever ...	Negative.
3	Male	10	Lateral sinus thrombosis, with septicæmia due to a bacillus of the Gärtner group.	Numerous colonies, mostly of a Gärtner-like bacillus similar to that from blood. Also streptococcus salivarius.
4	Male	47	Angina Ludovici ...	Negative.
5	Female	27	Actinomycosis of lung ...	Negative.

The two positive cases in this table require some further comment. *No. 1* was a case of typhoid fever, fatal at the end of the fourth week, with incipient pneumonia. Death was from intestinal hæmorrhage. The heart blood was sterile after death, but the spleen yielded abundant *B. typhosus*. The fluid from the lung yielded mostly a form of *B. coli*, with a fair number of streptococcus salivarius, practically identical in reactions with the streptococci from the aortic wall. *Case 3* was one of otitis and lateral sinus thrombosis : from the clot in the sinus, twice from the blood during life, and also from the stools a bacillus was isolated which belonged to the Gärtner group, but produced indol, did not give any alkaline reaction in milk and was not pathogenic for the mouse. The majority of the colonies from the aorta after death were identical with this bacillus.

SUMMARY AND CRITICISM OF THE FOREGOING RESULTS.

In the tables just given I have plainly set forth the actual results of a series of cultures from the substance of the aortic wall. In 13 cases there was no reason to suspect an infective condition ; in 36 cases infection was or had recently been present.

Invasion of the arterial wall by microbes has been assumed, in infective disease, in order to explain the histological changes which have at times been described. In one disease, syphilis, the spirochæte has several times been demonstrated in the vessel wall. My object has been to investigate the matter, in a wide series of infections, by the simplest and most direct of all methods—actual cultivation. I have now to consider what value can be attached to the results I have described, and whether any conclusions can be drawn from them.

I have already given reasons for believing that the technique adopted was sufficiently rigorous to avoid ordinary contamination

from the conditions of the dead house, and I think I may add that the results obtained bear witness that such contaminations were practically absent. Only in two or three cases out of the 49 did I meet with colonies in the culture tubes which were probably contaminations. It will be admitted that, of all organisms likely to occur as chance contaminations of the dead house, *Bacillus coli* would stand in the first rank. I never met with that bacillus except in four cases of *B. coli* infection of the urinary tract. Further, the tables bear witness that on the whole, when a positive result was obtained, the organism isolated was one identical with the primary infection. Where this was not the case, it was usually one of the common saprophytes of the body, often present as a secondary infection and at times recoverable from healthy tissues by such methods as were employed by Conradi.

In those cases, therefore, in which I have recorded a positive result, I believe that it may be accepted as fair evidence that the organism had actually been present in the arterial wall during life. A negative result is necessarily of less value, for invasions of the arterial wall are probably, as a rule, scanty and localised, and it is a matter of chance whether a culture from any given spot reveals their presence. It will have been seen from the tables that the number of colonies obtained was exceedingly small, except in one or two cases. I cannot say whether the latter represent an abnormal severity of infection or whether I chanced to strike a rich local focus. For such reasons I imagine that my results underestimate the frequency with which local foci of infection are present in the arterial wall and perhaps greatly underestimate it.

Turning now to the different infections which were studied, it is seen that they present certain differences in the liability of the arterial wall to invasion.

In *acute streptococcal septicæmia* this liability appears great. In four out of six cases of blood infection with *streptococcus pyogenes* I found this organism in the aortic wall, once in very large numbers. This accords with the known wide distribution of this coccus in the tissues in acute septicæmia.

In *acute staphylococcal septicæmia* much the same is true.

In *malignant endocarditis*, on the contrary, I failed to find the infecting organism in the aortic wall. Out of seven cases examined, only one yielded any result, and here the organism was not that causing the primary infection. It is not always easy to recover the infecting organism from the blood during life, and it may be conjectured that the processes of septic embolism which occur in malignant endocarditis are somewhat too gross to involve the *vasa vasorum*.

In *acute rheumatism*, of which three cases were examined, one yielded a positive result, the organisms being the relatively non-virulent streptococci commonly encountered in rheumatic affections.

In *acute pneumonia* and *acute peritonitis* the results were negative. When, however, we turn to *infections of the urinary tract with B. coli and its allies*, the positive results are marked, and are seen even when there is no proof of general invasion of the blood stream by the bacillus. Of my five cases, no less than four showed the presence of the bacillus in the aortic wall.

I regret that I have had only one opportunity of investigating *typhoid fever*, because this is one of the infective diseases which, on clinical grounds, have been credited with the causation of arterio-sclerosis. The result was positive, but the organisms found were

streptococci. This is not surprising, for it is my experience that it is exceptional to recover *B. typhosus* from the heart blood after death, though streptococci are often found as secondary infections. True typhoid septicæmia is mainly confined to the first week or two of the disease, and the question arises how far the effect of typhoid fever, in causing arterial degeneration, is due to *B. typhosus* itself or to such secondary infections—a question which I have no means of answering. The single case of *paratyphoid fever* which I examined yielded a negative result, but a case of acute infection with an allied bacillus, invading the lateral sinus from the middle ear, showed invasion of the aortic wall.

CONCLUSIONS.

Although the number of cases investigated by the method of direct culture has been too limited for any final conclusions, my results certainly suggest that the commonly assumed view as to invasion of the aortic wall by way of the vasa vasorum, in general infections of the blood stream, is warranted by facts. There is of course, no reason why, in such generalised infections, the aortic wall should escape, more than any vascular tissue, but I venture to hope that my results may be of some value as a positive demonstration that such local infection does occur. Bacteria have doubtless been demonstrated before, in sections of the vessel wall, but I believe this is the first attempt at their cultivation and identification.

As the result of this identification, it appears that, as might have been expected, the organisms invading the aortic wall are usually identical with those of the primary infection. But it will be noted that this was not always so, and that when the microbe found was heterologous, it was almost always one of the common saprophytes of the body. This also need cause no surprise in face of the fact that such saprophytes are often facultative parasites and common agents of secondary infection. In particular I would call attention to the frequency with which I met with streptococci of the types common in the alimentary canal, especially with the form known as streptococcus salivarius, well known as a common secondary infecting agent. This was found in 7 out of 17 cases yielding a positive result. If, as I believe possible, such organisms not rarely gain temporary access in small numbers to the blood stream, even in health, it may be that the aorta is one of the spots which may serve as a temporary nidus for their growth. It will have been seen that streptococcus salivarius was one of the organisms obtained in the single case which yielded a positive result in the series of 13 cases of death by accident or non-infective disease by which I tested my technique.

In 16 cases of fatal infective disease, out of 36 examined, I obtained some sort of positive result on culture, though in one or two the bacteria grown were probably accidental contaminations. If this be so in fatal cases, it is probable that a similar invasion of the aortic wall may often have occurred also in cases which recover, though perhaps in lesser degree. Such invasion is probably local and temporary, being ultimately or indeed soon overcome, but while it lasts we must believe it capable of exciting a local inflammatory reaction, and after it is overcome this may be replaced by a focus of fibrosis. In such a way as this I conceive that almost any acute general infection may leave behind it, as a chance sequel, minute foci of damage along the course of the vasa vasorum of the middle

coat of the aorta. The damage may be very trivial in itself, but when, later in life, the vessel becomes exposed to any undue stress or begins to wear out under the ordinary strain of life, such small foci may serve to determine the *distribution* of the visible sclerotic changes in an artery; they might in part account, for instance, for the incidence of nodular sclerosis.

How far all this applies to arteries other than the aorta I cannot say, because my observations have been carried out mainly on the aortic arch. I have met with no evidence of infection of the aortic wall, in such conditions as I have been describing, other than by way of the vasa vasorum, as will be seen in the next section of this report. I know that there is an infective endarteritis, comparable to infective endocarditis and sometimes associated with this, but it is a rare condition and one with which I am not here concerned. The question of the infection of other arteries in a way similar to that demonstrable in the aorta would seem therefore to depend upon the degree to which their walls are furnished with vasa vasorum. This is a point upon which anatomists have left us in much ignorance, and it is a piece of work which ought to be done. My own impression from the histological study of many arteries, is that vasa vasorum, at least in the middle coat, are confined to the aorta and its largest branches, and this may possibly be the reason why nodular sclerosis is mainly confined to these situations. It would need elaborate injection experiments to settle the question, and these I have had no time to attempt.

Here I leave the matter of direct proof of infection of the arterial wall and pass to the histological evidence that such infection may have occurred, from the presence of inflammatory foci in the vessel wall.

(2) HISTOLOGICAL INVESTIGATION OF THE AORTA IN INFECTIVE CONDITIONS.

In the majority of the cases culturally investigated I have gone on to histological examination of the vessel wall, and I have done this also in many cases of infective disease not investigated by direct culture. My aim was to confirm and, if possible, extend the results reported by others as to the effect of certain infections upon the wall of the aorta.

The one outstanding example of an infective process which commonly causes severe damage to arteries is syphilis. The syphilitic affections of arteries have been so fully studied that, although I have examined material from a very large number of cases, I have little to add to what is already well known.

Other infective diseases, however, are in a different position. The various specific fevers have often been accused of causing arterial disease, mainly on clinical grounds; such clinical evidence was often weighty, but for the most part lacked histological confirmation. Köster long ago put forward the hypothesis that arterio-sclerosis was traceable to small foci of inflammation about the vasa vasorum in the outer and middle coats of the vessel. It has been objected that this was before syphilitic aortitis was adequately recognised and that many of the cases upon which he relied may have been syphilitic. In more modern times various observers have reported the finding of inflammatory foci in the media of the aorta, especially in the ascending arch, in fatal cases of certain of the specific fevers. Thus Oskar Klotz reports the presence of such foci in almost all cases of

fatal typhoid and rheumatic fever. It is not suggested that the inflammatory damage approaches in severity that seen in syphilis, but even trivial lesions, as I have already said, may serve to determine the incidence of sclerotic changes in a vessel later subjected to undue mechanical strain, or to any other of the recognised causes of arterio-sclerosis, and they may, indeed, initiate degenerative processes.

I therefore determined to examine all the various infective diseases which chanced to present themselves in the post-mortem room, without any conscious selection, in order to ascertain the frequency of occurrence of even slight inflammatory lesions in the aortic wall, such as might be the possible starting points of later degenerative change. The material taken was usually the aortic arch, because this is stated to be the commonest seat of such lesions, but in certain cases the abdominal aorta and other large vessels were examined.

Methods of Study.—The material was hardened either in formalin or in dilute alcohol. It was then cut in paraffin and stained. Various stains were employed: the most useful was Pappenheim's stain for plasma cells, but I used carbol-thionin blue very commonly and also van Gieson's stain.

General Considerations.—It is not always an easy matter to determine whether or not a given cellular streak in the arterial wall or its adventitial sheath deserves to rank as inflammatory in nature. Where plasma cells could be detected I have frankly accepted the lesion as inflammatory for I cannot detect these cells in normal vessels. In the absence of plasma cells I have felt less certainty, and have been obliged to form an opinion from the relative abundance of cells along the course of the vasa vasorum.

It might be supposed that the arteries of those dying a violent death while in full health would offer a standard by which to judge, but it is a standard which must be used with caution. It is difficult to get a complete history in such cases, and it is often possible that the patient may have had some specific fever or other infection at a recent date. However, so many of the aortas which I have examined have shown nothing which could possibly be regarded as an inflammatory infiltration along the vasa vasorum, that I feel some confidence that my conception of the normal is fairly correct.

The vasa vasorum in a normal aorta are conspicuous in the adventitia, and it is easy to see which are arteries and which veins. Their course is mapped out by the stained nuclei of their own coats and of the endothelium of the lymphatic channels which accompany them: scanty groups of lymphocytes are also seen along the course of these lymphatics, but in sections stained by Pappenheim's method I have not been able to detect plasma cells. The number of nuclei along the course of the vessels is much greater than in the loose connective tissue around, whence the "mapping" of their course. Smaller vessels are abundant at the line of junction of the media and adventitia, running concentrically with the lumen of the vessel.

Here and there a branch dips in at right angles into the tunica media, and soon breaks up into branches which again run parallel with the circular coats of muscular and elastic tissue. In the normal aorta these small branches, capillary in size, can be detected only in the outer third of the media. I believe that their presence in its inner layers is always pathological. In chronic inflammatory conditions of the vessel wall the media may be vascularised throughout, and capillary channels may even be found in the thickened

intima. This is comparable with the vascularisation of the heart valves in chronic endocarditis or with that of the cornea in certain chronic inflammations. So important is free access of blood in the inflammatory process that, given sufficient time, new vessels are formed to conduct it, even in tissues normally destitute of them.

The vasa vasorum in the media are always less conspicuous than those of the adventitia. They are smaller and contain fewer structural elements, but their course is still mapped by nuclei more abundant than those of the surrounding tissues. The cells are mainly those of the capillary endothelium and of the endothelium of the lymph-channels which may be assumed to accompany the vessels, possibly with a few lymphocytes here and there. After studying sections of a large number of aortas one arrives at a certain conventional standard of the distinctness with which the vasa vasorum are normally mapped out. I regret that I cannot offer any more definite statement as to the phenomena of chronic inflammation of the vessel wall in its slighter degrees, but after much heart-searching, I can only say that unduly distinct "mapping" of the capillaries in the media, as compared with that seen in the presumably normal vessel, is the only criterion which I have been able to discover. In the more marked degrees the presence of plasma cells along the course of the vasa leaves no room for doubt.

With this preamble I pass to the actual cases studied. I have examined 62 cases in all, but two of these were normal vessels examined as controls, and 23 were cases of syphilitic disease of the arteries. This leaves 37 cases of the various infective diseases which have been less extensively studied from my present point of view.

I. ACUTE STAPHYLOCOCCAL SEPTICÆMIA.

Case 1.—Male, age 15. The primary lesion was a crushed finger. Death was from staphylococcal septicæmia, with secondary abscesses in the lungs. The aorta shewed only slight fatty streaks in the intima.

Histological result.—Vasa somewhat engorged in adventitia. No evidence of inflammatory change there or in media.

Case 2.—Female, age 23. Primary lesion was a carbuncle. Death from staphylococcal septicæmia two days after it was opened. No metastatic abscesses. Culture from aortic wall negative.

Histological result.—Aorta normal. No inflammatory changes along vasa vasorum.

Case 3.—Female, age 10. Primary lesion was an abscess in the suprarenal, invading the kidney. Semi-purulent pleural and pericardial effusions, yielding staphylococcus aureus. Culture of the intrapericardial part of the aortic arch yielded colonies of a staphylococcus probably different from that of the primary infection (see Case 2 in the table of staphylococcal septicæmias in the preceding section).

Histological result.—The intrapericardial portion of the ascending arch of the aorta shews a non-purulent inflammatory infiltration of the adventitia with lymphocytes, plasma cells, and a few polynuclear leucocytes. No cocci found microscopically. The infiltration extends a little way along the vasa into the media here and there, but it is trivial in this

situation. It will be noted that the piece of aorta cut was in close proximity to the inflamed pericardium, so that the mischief may have resulted from direct extension of the inflammation.

II. ACUTE STREPTOCOCCAL SEPTICÆMIA.

Case 4.—Male, aged 14. Empyema of 6 weeks' duration, drainage, death from confluent broncho-pneumonia with general streptococcal septicæmia.

Histological result.—The common carotid was the only vessel examined. It proved quite normal.

Case 5.—Male, age 2 months. Cellulitis of scalp, death after 10 days' illness, with purulent peritonitis and general streptococcal septicæmia.

Histological result.—The thoracic aorta shews the vasa vasorum in the adventitia and media somewhat more distinctly mapped out than normal, but I cannot affirm the presence of actual inflammation.

Case 6.—Female, aged 34. Septic pharyngitis after swallowing a rabbit bone. Death in 14 days from streptococcal septicæmia. Culture of the aortic arch yielded streptococci.

Histological result.—The aortic arch shews nothing abnormal.

Case 7.—Male, age 9 months. Diphtheria of some 7 days' duration; tracheotomy; death from broncho-pneumonia and streptococcal septicæmia. The aortic arch yielded streptococcus pyogenes on culture, but not diphtheria bacilli.

Histological result.—The descending thoracic aorta and the common carotid were cut. The aorta shewed marked inflammatory changes. The cellular tissue of the adventitia and the adjacent fat were densely infiltrated with plasma cells. The infiltration was markedly perivascular at the junction of the adventitia and media, and extended along the vasa vasorum for a short distance into the media. Bacteria were recognisable in the fat and cellular tissue outside the artery: most were Gram-negative bacilli, but a few pairs of Gram-positive cocci were seen, though not in the middle coat.

The carotid shewed similar but less advanced changes: the adventitia was infiltrated and shewed a fair number of streptococci. The inflammatory changes barely extended to the media.

The histological pictures in this case were very striking, and clearly shewed an attack on the arterial wall from without.

Case 8.—Female, age 50. Streptococcal septicæmia following an operation on a carbuncle primarily due to staphylococci. The patient had diabetes. Culture from the aorta was sterile.

Histological result.—Clumps of streptococci were found in the vessels of the adventitia of the aorta, chiefly in the veins. I could not find them in the media. Perivascular infiltrations were slight, but recognisable, even in the outer layers of the media.

III. MALIGNANT ENDOCARDITIS.

Case 9.—Male, age 41, the subject of old gastric ulcer. Died of malignant endocarditis of the aortic valve after six or seven weeks' illness. *Streptococcus pyogenes* was cultivated from the blood during life. A patch on the ascending part of the aortic arch tore across in removing the vessel, and was supposed to be an area of malignant streptococcal endarteritis. On examination this could not be confirmed: it was only a patch of nodular sclerosis, with subjacent inflammation.

Histological result.—A section of the aorta, where torn, shews ordinary atheromatous thickening of the intima, with fat and lime salts. Beneath this the adventitia and media shew much chronic inflammation—groups and strings of inflammatory cells extending through the whole thickness of the media, which is vascularised throughout. Away from the patch this is much less marked. No streptococci could be found in the aortic wall in sections stained by Gram's method. I cannot affirm that the changes found in the aorta in this case were due to the malignant endocarditis, but they were more marked than in most cases of nodular sclerosis.

Case 10.—Male, age 47. Died of gonococcal endocarditis of the aortic valve, not visibly affecting the aorta. There was some ordinary early nodular sclerosis of the arch.

Histological result.—Sections through a plâque of nodular sclerosis in the arch shew a moderate degree of infiltration along the vasa of the adventitia and media, with plasma cells, lymphocytes and mast cells. But this is opposite the intimal plâque, which is clearly of some standing; there is no proof that it is related to the endocarditis.

Case 11.—Male, age 32. Typhoid fever at 14 years, and rheumatic fever at 25 years of age. Severe mitral stenosis and some tricuspid stenosis. Died on the 9th day of a pneumonia due to the pneumococcus. There was some recent acute vegetative endocarditis superimposed on the old valvular lesions. There was some nodular sclerosis of the aorta, most marked in the abdominal part, where there was an elongated plâque occluding one lumbar artery. The heart blood was sterile, post-mortem; cultures from the abdominal aortic plâque yielded undeterminable bacilli which bore no relation to the primary disease.

Histological result.—The plâque in the abdominal aorta was cut and shewed the ordinary appearance of nodular sclerosis. The media presented evidence of old damage; it was vascularised throughout, and some blood channels, lined by endothelium, were found in the deeper part of the intimal plâque. Scanty inflammatory infiltration was present along the vasa vasorum, with a few groups of plasma cells. The condition was more suggestive of former damage by rheumatism or typhoid than of any recent infection, and considering the patient's age, is not without significance in relation to his former infections.

Case 12.—Female, age 12. Died of streptococcal endocarditis after an illness of 6 months' duration. No very luxuriant vegetations and no gross infarcts, but there were microscopic infarcts in the kidneys. Pus was present in one wrist joint. Streptococci were cultivated from the heart blood, but a culture from the aortic arch was sterile.

Histological result.—The ascending arch of the aorta shews chronic inflammation of the adventitia, with abundant plasma cells. In the media are a few small foci of infiltration along the vasa vasorum, with a few plasma cells. There was no recognizable pericarditis so that the lesions found can hardly have been by direct extension from the pericardium.

Case 13.—Female, age 22. A case of puerperal septicæmia, with acute malignant endocarditis of all the heart valves, of 10 days' duration. The infecting agent was streptococcus salivarius. The body shewed petechiæ everywhere, and there were infarcts in the lung, spleen, and kidney. A culture from the aortic arch proved sterile.

Histological result.—The aorta shews little sign of inflammation, though one or two plasma cells were found along the course of the vasa vasorum. Several large groups of degenerate cocci, in pairs, were found in the media, not in relation to the vessels, but surrounded by areas of degeneration in the medial tissues.

IV. SCARLET FEVER.

I have had no opportunity of studying the arteries from cases of recent scarlet fever, but I have examined in detail 3 cases of juvenile arterio-sclerosis in which it seemed possible that scarlet fever was the primary cause of the mischief. In one of these the attack of scarlet fever was so remote, and so many other complicating factors were present, that I do not feel justified in including the case here. The other two cases are, I think, worthy of full description, though only in one of them is the evidence at all convincing that the mischief was primarily due to scarlet fever. In my previous report I pointed out the importance of cases of nodular and other forms of arterio-sclerosis in young persons; they are more likely than any others to throw light on the causation of the condition because senility and other common alleged causes of sclerosis can as a rule be excluded. I described in that report a case of nodular sclerosis in a girl of 17, the subject of prolonged pyelonephritis, in which it seemed possible that the arterial mischief was due to infection with *Bacillus coli*. I am therefore fortunate in having come across two somewhat similar cases in which an infective origin may reasonably be assigned to the lesions found.

Case 14.—Female, age 16. Death occurred from cerebral tumour. Four years previously she had suffered from scarlet fever—evidently a severe attack, for she was 12 weeks in hospital. Since that time she had suffered from headaches—in part doubtless due to the cerebral tumour. She was found, after death, to be the subject of primary granular kidney. The kidneys were normal to the naked eye, but on section they shewed thickening and obliteration of the small arterioles, with interstitial nephritis.

There was hardly any sign of past glomerulo-nephritis. The heart weighed 13 oz. The arteries were everywhere thicker and more rigid than normal, with pronounced intimal thickening, hyperplastic and fibrous—a condition presumably due to increased blood-pressure. In addition, there was early nodular sclerosis of the aorta, which presented pearly plaques, of cartilaginous consistency, at the origins of the carotids, renals, &c., and a plaque running obliquely for 2 inches down the back of the descending thoracic aorta. These plaques shewed no sign of calcification and hardly any fatty degeneration. I was unable to make cultures from the aorta, because when I received it, it had already been placed in spirit.

Histological result.—Sections were cut of the aortic arch away from the plaques, of the descending thoracic aorta across the large plaque, of the innominate artery, the common iliac, the origins of the carotids and the origin of the left renal.

In all the arteries there was diffuse intimal thickening. Signs of past inflammation in the middle coat were found in various situations. The aortic arch, at a distance from the plaques, shewed in one or two places cellular infiltrations spreading from the adventitia along the vasa for a little way into the media: about one such patch was some fibrosis of old standing. No such changes were found in the innominate or common iliac. But opposite the plaques in the aorta the changes in the media were much more conspicuous, and almost limited to the part underlying the plaque. They were found wherever there was a plaque, and consisted in streaks of chronic inflammation running concentric with the muscle fibres in the outer third of the media, shewing lymphocytes, plasma cells, fibroblasts and sometimes fibrosis of longer standing. The changes did not approach in extent those seen in syphilis, but they were sufficient, in sections stained with orcein, to cause manifest small gaps and chasms in the elastic tissue layers. No bacteria were demonstrable in these foci, and the adventitia was normal. The lesions suggested an affection of some standing.

The interpretation which I am disposed to place upon the above facts is as follows. The lesions in the arterial media seem old enough to be referred back to the attack of scarlet fever four years previously. Whether they were due to the scarlatinal virus itself or to secondary streptococcal complications cannot be said. They constituted weakened spots in the arterial wall. Then came granular kidney and increased blood pressure with diffuse intimal thickening in all the arteries, and with special localized thickenings opposite the spots of special weakness, *i.e.*, nodular sclerosis governed in its distribution by the old scarlet fever lesions.

Case 15.—Female, age 15. Death from failure of the heart in mitral stenosis, with general dropsy. The mitral stenosis appeared traceable to an attack of scarlet fever.

The pulmonary artery shewed raised reddish areas and fatty patches in the intima. The aorta shewed fatty streaks down the back of the vessel, increasing away from the heart, and culminating just above the bifurcation of the abdominal aorta in a large raised fatty plâque, elongated in shape like a Peyer's patch. There was no interstitial nephritis. An agar culture from the plâque in the abdominal aorta yielded only a few miscellaneous colonies which I regarded as contaminations and did not pursue further.

Histological result.—The changes in the pulmonary artery were purely intimal, consisting of localized fibrous thickenings and slight fatty changes, presumably associated with the raised pulmonary blood pressure in mitral stenosis. No inflammatory infiltrations could be detected in the media.

A section across the large plâque in the abdominal aorta showed the intimal thickening to consist of loose fibrous tissue with scattered cells which were in a state of fatty degeneration, though there was not much fat in the plâque as a whole. The plâque appeared to have originated in the massive bundle of longitudinal muscular fibres and elastic tissue which I believe to be usually present in the intima at the back of the aorta just above the bifurcation; this is a common site for a large plâque in nodular sclerosis. In this instance the bundle had undergone mucoid or hyaline degeneration of its stroma. The surface layers were more cellular, showing numerous spindle shaped fibroblasts. The media opposite the plâque was scarcely thinned, and was in fairly good condition, but in its outer layers it showed some streaks of cellular proliferation about the vasa vasorum.

Although there was this evidence of slight medial inflammation, which may have been of scarlatinal origin, I am not disposed to lay such stress in this as I do in the preceding case, on the inflammatory origin of the arterial affection, for the conspicuous plâque in the abdominal aorta was but the culminating exaggeration of a series of degenerate fatty streaks down the vessel which I believe to depend, as regards their distribution, on local developments of the longitudinal musculo-elastic layer of the intima. To this matter I shall recur in discussing the general conclusions to be drawn from the present series of observations.

V. RHEUMATIC FEVER.

The evidence that the arteries may be affected in rheumatic fever is abundant, and has been well summarised by Prof. Oskar Klotz in a recent paper (*Jour. of Path. and Bact.*, Vol. XVIII. (1913), p. 259). The French observers have paid particular attention to this subject. It is claimed that the arteries may be attacked in two ways: there may be a periarteritis with some invasion of the media, or a primary endarteritis associated with thrombosis or embolism.

The latter condition is probably of some rarity, and the personal observations of Klotz seem from his descriptions to be limited to the lesser degrees of the former condition. My own limited experience is in accordance with the observations of Klotz ; I have examined the aorta in seven rheumatic cases.

Case 16.—Female, age 11. History of chorea and rheumatism. Adherent pericardium, mitral regurgitation. Old caseous gland at root of one lung, causing bronchiectasis by pressure on a bronchus. Ductus arteriosus not quite closed : a bristle could just be passed along it.

Histological result.—Both the aorta and pulmonary artery were cut in the neighbourhood of the ductus arteriosus. The layers of the media were here irregularly arranged, but apart from this and from engorgement of the vasa vasorum due to systemic venous overfilling, both the aorta and the pulmonary artery show definite foci of inflammatory infiltration along the vasa in the outer layers of the media. They have resulted in slight local damage to the elastic laminæ, manifested by gaps and small clefts in sections stained with orcein.

Case 17.—Male, age 14. Rheumatic fever five years ago and twice since, the last attack being two years prior to death, which was due to mitral and aortic valvular disease. No recent endocarditis. Some fatty streaks were present in the aortic intima. A culture of the arch was sterile.

Histological result.—The transverse arch of the aorta shows numerous but slight cellular infiltrations about the vasa in the outer third of the media, so that they are mapped with abnormal distinctness, and show here and there one or two plasma cells. A few similar foci are seen about the vessels in the adventitia. No bacteria found. The media as a whole was in good condition, and there was little intimal thickening.

Case 18.—Female, age 18. Chorea and rheumatism at 14. Hemichorea for five weeks ; admitted to hospital hemiplegic and moribund. No gross cerebral lesion present. There was slight myocarditis, and both old and recent endocarditis. A culture from the aortic arch yielded colonies of streptococci of the salivarius and faecalis types.

Histological result.—The aortic arch shows a good deal of inflammatory change, and even hæmorrhage, in the adventitia. The inflammatory infiltration, with distinct plasma cells, passes here and there along the vasa for a little way into the media, but the disturbance of the media is slight. No bacteria can be found in the section.

Case 19.—Male, age 22. Typhoid fever at 11 years old. First attack of rheumatism at 17 ; two milder attacks since. No recent rheumatism. Death from valvular disease, aortic and mitral, with adherent pericardium.

Histological result.—The changes found in the aortic arch were so slight that I should hesitate to term them inflammatory. The most that can be said is

that the vasa vasorum at the junction of the adventitia and media are mapped with some extra distinctness.

Case 20.—Female, age 12. First attack of rheumatic fever eight weeks prior to death, which resulted from cardiac dilatation and failure. There was interstitial myocarditis and recent vegetations were present on the mitral valve. A culture of the ascending aortic arch was sterile.

Histological result.—As in the last case the changes in the aortic arch were very slight and could scarcely be deemed inflammatory. The media was almost normal; the intima showed some patchy thickening and early degeneration.

Case 21.—Male, age 14. Three previous attacks of rheumatic fever, leaving valvular disease. Died in a fourth attack of three weeks' duration. There was recent mitral and aortic endocarditis as well as old, and Aschoff's nodes were present in the myocardium.

Histological result.—As in the last two cases, I could not find in the aortic arch any certain inflammatory changes, though the vasa vasorum were very distinctly mapped at the outer boundary of the media. The media itself seemed normal and also the intima.

Case 22.—Male, age 12. First attack of rheumatic fever 2½ years, the second attack two months, prior to death. The last attack was severe, with numerous rheumatic nodules, pericarditis and general mediastinitis. There was recent endocarditis of the mitral and aortic valves, and myocarditis, with Aschoff's nodes. The heart's blood was sterile after death, but streptococcus salivarius was cultivated from the myocardium. No culture was made from the aorta in this case.

Histological result.—The aortic arch was examined in two places and also the origin of one common carotid. Definite inflammatory changes were found—perivascular infiltrations about the vasa in the adventitia and in the outer half of the media, with plasma cells. The lesions were local in distribution; only two or three patches were found in a section across the entire descending arch. In the carotid the changes were similar, but did not extend beyond the junction of adventitia and media.

VI. MEASLES.

Six cases of this disease were examined.

Case 23.—Female, age 18 months. Death from bronchitis and broncho-pneumonia complicating measles. The aorta was normal to the naked eye.

Histological result.—Sections were made across the whole aortic arch. The vasa vasorum were large and well developed in the media, and many of them showed slight cellular proliferation around, much as in the slighter cases of rheumatic affection of arteries. I could not find any certain plasma cells.

Case 24.—Female, age 9. Death from pneumococcal meningitis, secondary to acute otitis media. She had just had measles.

There were a few fatty streaks in the intima at the origin of the aorta.

Histological result.—The arch appears normal, with no sign of inflammation anywhere.

Case 25.—Male, age 4. Measles; death from broncho-pneumonia four days after the rash came out.

Histological result.—Sections made across the whole arch at the junction of its ascending and transverse parts. There are areas of slight inflammatory infiltration about the vessels in the adventitia, with a few plasma cells. The inflammation extends here and there a short distance into the media, but this is very little affected, and I cannot find plasma cells in it.

Case 26.—Male, age $2\frac{1}{2}$ years. Died of broncho-pneumonia on the eighth day of measles.

Histological result.—A section of the aortic arch through the region of the ductus arteriosus shows no sign of inflammation either in adventitia or media.

Case 27.—Female, age 2. Measles a month before death. Admitted to hospital with fever and a double mitral murmur. Died with acute endocarditis of the “rheumatic type,” and with pericarditis and peritonitis. A culture from the ascending arch of the aorta was sterile.

Histological result.—Section of the ascending arch showed a considerable amount of inflammation in the adventitia. A vein was found full of polymorphonuclear leucocytes and there was infiltration about the vasa; a few plasma cells were detected. The inflammation extends along the vasa to the outermost layers of the media, but no plasma cells could be found here.

Case 28.—Male, age 11 months. Death from broncho-pneumonia in measles.

Histological result.—Section across the whole aortic arch showed moderate inflammatory changes in the adventitia, with pronounced mapping of the vasa, especially at the junction of the media and adventitia. There is definite extension of the infiltration into the outermost layers of the media.

VII. INFECTIONS WITH THE TYPHOID-COLI GROUP OF BACILLI.

Case 29.—Female, age 29. Died at the end of the fourth week of typhoid fever, complicated by severe bronchitis and by hæmorrhage from the bowel. The aorta showed well marked fatty streaks in the intima. A culture of the arch yielded streptococcus salivarius.

Histological result.—Frozen sections of the aortic arch and of one carotid showed a thickened intima with patchy fatty degeneration. Paraffin sections were made from four parts of the aorta, from one carotid and one external iliac artery.

The ascending arch shows unmistakable inflammatory infiltration along the vasa, abundant in the adventitia and well marked in the outer third of the media. The transverse arch and descending thoracic aorta show much less evidence of inflammation,

though cellular infiltrations can still be recognised in the adventitia. In the abdominal aorta the same changes are more marked again, but the media is only very slightly affected. The carotid artery shows no inflammatory changes and the external iliac shows only, at one spot, a wedge of young fibrous tissue passing obliquely from the adventitia into the media : this wedge does not show any sign of a vessel in it.

Case 30.—Female, age $4\frac{1}{2}$ years. Death from what appeared to be paratyphoid fever. The illness was very short and was supposed, during life, to be Henoch's purpura. The small intestine, after death, showed lesions resembling those of typhoid fever, but they yielded, on culture, *B. paratyphosus B.*, and *B. pyocyaneus*. A culture from the aortic arch was sterile.

Histological result.—The aortic arch shows barely any sign of inflammation, but the vasa are rather more distinctly mapped than normal. At one spot in the outer part of the media is a vessel with slight cellular proliferation round it, and here one or two bacteria could be recognised. A patch of about a dozen bacteria were found at another spot in the media, not in relation to a vessel.

Case 31. Male, aged 10. Lateral sinus thrombosis in otitis media. Secondary infarcts in the lungs. The infecting organism (obtained twice from the blood during life, from the clot in the lateral sinus and from the stools) was a bacillus of the Gärtner group, not forming any alkali in milk and producing indol. It was not pathogenic for the mouse. The patient's blood clumped the bacillus readily, but did not clump the classical Gärtner's bacillus. From the arch, after death, I cultivated the same bacillus and also streptococcus salivarius.

Histological result.—The vasa vasorum in the adventitia of the aortic arch and at its junction with the media, are mapped by slight inflammatory infiltration, but the media itself has almost wholly escaped : only traces of infiltration are present in one or two spots at its extreme outer margin. No bacteria could be found in the vessel microscopically.

Case 32.—Female, aged 47. Died from pyonephrosis of two years' duration. The aorta and carotids appeared normal. The heart's blood was sterile after death and no growth occurred in a culture from the aortic arch.

Histological result.—Only the carotid was examined. It showed no inflammatory changes in the adventitia or media. The intima was diffusely thickened.

Case 33.—Female, aged 50. Death from calculous pyonephrosis involving both kidneys. *B. coli* was present in the urine during life. The aorta showed general early nodular sclerosis, most marked close to the heart. On the convexity of the arch and at the origin of the innominate were two plaques of intimal thickening, larger than the rest, pearly white in colour. A culture from the aortic arch yielded coliform bacilli (*B. alkaligenes faecalis*,

B. lactis aërogenes). A culture from the innominate yielded 2 colonies of *B. coli communis*.

Histological result.—Only the innominate was examined.

The intimal plâque showed the ordinary appearances of nodular sclerosis, with fatty and hyaline changes in its deeper parts. The media showed some diffuse degeneration. At the junction of the media and adventitia, opposite the plâque but not elsewhere, there was manifest chronic inflammation, moderate in degree and chiefly about the vasa vasorum. The infiltration extends here and there a short distance into the media. Several large groups of coliform bacilli with bipolar staining were encountered both in the adventitia and in the media, but only opposite the intimal plâque.

Case 34.—In connexion with the preceding cases I may refer to one which I described in my previous report. Female, age 17, dying of pyelonephritis of 4 months duration. Pearly plâques of nodular intimal thickening were present in the aortic arch and about the origins of the great vessels at the root of the neck. In this case there were conspicuous inflammatory infiltrations about the vasa in the outer part of the media, much more marked than in any of the above cases, and groups of what appeared to be Gram-negative bacilli were found in the spots affected.

VIII. TUBERCLE.

A few arteries from cases of tuberculosis were examined, but need not be described in detail. It is known that some degree of obliterative endarteritis may be present in the cerebral arteries in tuberculous meningitis, and I have sections showing this. But in two cases specially examined in the present series I failed to find the lesion, which is clearly an inconstant one.

The aorta from a case of acute miliary tuberculosis—a boy of 13—proved normal. I examined the arteries exposed in the wall of a pulmonary cavern in chronic phthisis; they were blocked by organised thrombus and their walls were in process of destruction by caseating inflammation. These observations scarcely concern the question here at issue.

IX. SYPHILIS.

For various reasons I propose to say little about the 23 cases of syphilitic arteritis which I have studied in the course of this research. In my former report I dealt at length with this subject. The syphilitic lesions of arteries are now well known, and the observations which I have made are in complete harmony with currently accepted views. No other infection wreaks such damage as syphilis upon the arterial wall, and the very intensity of the mischief offers an almost certain clue to its nature. My own observations include nothing new, and the only ones which seem to me worthy of record concern the very early stages of the affection with which I have chanced to meet. It was my practice to examine any vessel presenting unusual appearances, and I thus met with two cases in which the lesions were so early that I failed to recognise them as syphilitic

until sections had been cut. As a rule syphilitic arteritis can be recognised with the naked eye by anyone with a little experience of its morbid anatomy.

Case 35.—Male, age 40. Died of double pneumonia on the sixth day. Several early nodules of arterio-sclerosis were found in the transverse portion of the arch and nowhere else. They were $\frac{1}{4}$ to $\frac{1}{3}$ in. in diameter, pearly white, and scarcely at all degenerate. The rest of the vessel was normal, except for a few fatty streaks in the intima. A culture from one of the nodules yielded no growth.

Histological result.—The changes were characteristic of syphilis. The media beneath the intimal plaques, but nowhere else, was broken up by extensive infiltrations along the vasa—lymphocytes and plasma cells being abundant. There was considerable destruction of the elastic laminae.

Case 36.—Male, aged 20. Death was from streptococcal septicaemia, following an axillary abscess secondary to a septic wound of the hand. The heart blood was full of streptococci and a culture from the aortic arch yielded some 200 colonies of streptococcus pyogenes. The arch presented several plaques of recent nodular sclerosis, quite similar to those in the last case, but the aorta was otherwise normal.

Histological result.—The changes were typical of syphilis. As in the last case the medial damage was extensive, and abundant infiltrations with lymphocytes and plasma cells had broken up the muscular and elastic layers. Streptococci were readily demonstrable in the sections.

In both these cases the microscopic lesions were so greatly in excess of anything I have seen in other infections that I have no doubt of their syphilitic nature. But this diagnosis was only reached when the sections came to be cut, so that it could not be confirmed by clinical history or Wassermann's reaction. I take no shame for not recognising them as syphilitic at the autopsy, for the lesions were identical, to the naked eye, with those seen in cases of juvenile sclerosis which I have previously described as possibly due to scarlet fever and to infection with *B. coli*.

Further, I have recently made a mistake in the reverse direction as the following case shows.

Case 37.—Male, age 27. A powerful young labourer killed by accident. The aorta was quite natural except for a single well-defined succulent plaque of nodular sclerosis at the origin of the great vessels of the neck, $\frac{1}{3}$ in. in diameter. Influenced by the two previous cases I supposed it to be a local early syphilitic aortitis, but Wassermann's reaction (after death) was negative, and microscopic section shewed no sign whatever of serious medial lesions.

It seems therefore that, however distinctive the anatomical changes in advanced syphilitic aortitis may be, some caution must be observed in diagnosis in the earlier stages of this condition until histological sections have been studied.

SUMMARY AND CONCLUSIONS.

In the conclusions drawn from the first part of this report, dealing with cultural results, I shewed that there was evidence of actual

bacterial invasion of the aortic wall in many common infective conditions, either by the primary infecting agent, or as a result of secondary infection. The second part of this report deals with the correlative evidence as to the part played by infection in the causation of arterial degeneration, to be derived from histological study.

Syphilis stands by itself; its important rôle in arterial disease is a matter already settled. When we turn to other infective conditions the first impression is that of the slightness of the inflammatory changes found in the outer and middle coats of the aorta and other large vessels as compared with the damage inflicted by syphilis. But although in degree they are relatively slight, in kind they are similar: that is to say, they consist in chronic inflammatory infiltrations, mainly along the course of the vasa vasorum, consisting chiefly of lymphocytes with a few plasma cells and some endothelial proliferation. They appear to leave behind them slight areas of fibrosis, and in well-marked cases slight breaks in the continuity of the elastic laminae are recognisable in suitably stained sections. The result of these small lesions is an impairment of the perfect integrity of the vessel: each spot affected must constitute a locus resistantiae minoris perhaps so trivial that of itself it may cause little harm, yet not without importance when other and more general causes of arterio-sclerosis come into play.

So slight are the lesions in many cases that I must confess that I have often been in doubt, in studying the series of vessels just described, whether the appearances were justly to be described as inflammatory. It would be easy to arrange my sections in sequence beginning with perfectly normal arteries and passing gradually to those in which the evidences of chronic inflammation were beyond dispute: the sequence would be almost unbroken, and I am unable to say precisely at what point the series of changes should begin to be deemed inflammatory.

For purposes of classification I divide the cases, other than syphilitic, into three groups, (1) arteries with no evidence of inflammation, (2) those with slight or doubtful evidence, and (3) those in which inflammatory changes were certainly present in the adventitia and media. Judged on such a basis my results may be tabulated as follows:—

Disease.	No. of cases examined.	Aorta normal.	Slight or doubtful evidence of inflammation in media and adventitia.	Definite inflammatory changes in media and adventitia.
Staphylococcal septicæmia...	3	2	1	0
Streptococcal septicæmia ...	6	3	1	2
Malignant endocarditis ...	5	1	0	1
Old scarlet fever	2	0	0	2
Rheumatic fever	7	0	4	3
Measles	6	2	2	2
Typhoid fever	1	0	0	1
Paratyphoid fever	1	0	1	0
Septicæmia due to Gärtner-like bacillus.	1	0	1	0
B. Coli infections	3	1	0	2
Totals	35	12	10	13

The table shows that, of 35 cases of general acute infections of 10 different kinds, the aorta was normal in 34 per cent., showed slight or doubtful evidence of inflammation in 29 per cent., and definite evidence of inflammatory change in the media and adventitia in 37 per cent. of the total.

These results confirm and in some respects amplify those which have been reached by others who have studied this subject. They must underestimate the facts, for chance sections from a single spot in a vessel may well fail to reveal changes which may have been present elsewhere. They go to show that in general infective diseases the aorta may not escape scot-free, even though the injury be trivial. And when it is remembered that few persons escape general infection at some period in their lives, it is not too much to say that we have here a probable cause, not perhaps of premature arterial degeneration as a whole, but at least of the premature local changes in the arterial wall which determine the distribution of some forms of nodular sclerosis. I willingly grant, with Jores, that many cases of nodular sclerosis are determined in their distribution by the local development of the bundles of the longitudinal musculo-elastic layer of the intima : I have examined many cases in which I am convinced that nodular sclerosis often begins thus as a purely degenerative process. But there are other cases, of which the most convincing are those of juvenile arterio-sclerosis of local type, and of which syphilis offers the most extreme example, in which local infective changes seem the important determining cause.

In a measure, too, these results serve to confirm Thoma's view as to the causation of arterio-sclerosis. No one, as I pointed out in my previous report, nowadays accepts Thoma's theory as a general explanation of all sclerotic changes in arteries. But the little primary lesions of the media with which we are here concerned are just what Thoma's theory demands as the initial impetus to intimal thickenings.

PART II.

The CALCIUM-CONTENT of the AORTA in HEALTH and DISEASE.

The primary object of this research was to ascertain whether the percentage of mineral salts, and especially of lime salts, in the arterial wall could be used as a *measure* of the degree of degenerative change present. On general grounds it seemed possible that this might be the case, for we know that degenerate arteries are usually loaded with lime salts, and that, with advancing years, these salts become microscopically demonstrable in the arterial wall even when the deposit cannot be recognised with the naked eye. Only in one form of arterial degeneration, that associated with syphilis, are calcareous changes habitually absent.

Previous investigations.

The calcareous changes in degenerate arteries have occasionally attracted the attention of pathological chemists, and scattered chemical analyses have been carried out, chiefly on diseased arteries, and

almost exclusively on the aorta. It is unnecessary to quote all the observations which have been made, for they have mostly dealt with small numbers of arterics and the writers have not attempted to draw any conclusions, so that from my present point of view they are almost valueless. I have only been able to find one paper dealing with the subject of calcareous changes in an adequate manner; it is by Gazert, and was published in 1899, (Deutsch. Archiv. f. Klin. Med., Vol. LXII, p. 390). This writer analysed 33 aortas, the analyses covering total nitrogen, ash, calcium, and fat. 12 of his cases were normal or approximately normal vessels in persons under 50. He gives his results in terms of the percentage of CaO in the dried vessel, and I find them to correspond fairly closely with my own. I shall refer to them again later. His calcium figures were obtained by dissolving the ash in hydrochloric acid, and precipitating the lime as oxalate. This admirable paper is however lacking in one respect; the clinical details are extremely meagre, so that it is difficult to draw from it conclusions of much practical value to the clinician. In particular, he takes no account of syphilis as a factor in arterial disease, naturally enough, for Doehle's paper had only appeared in 1895 and it was many years before syphilitic aortitis was duly recognised. Judging Gazert's figures in the light of my own experience, I feel fairly sure that some of his cases must have been syphilitic. His data, however, enabled him to insist on the enormous increase in the ash and in the calcium content of the aortic wall which occurs with advancing years. I am not aware of any paper which has appeared since that of Gazert which has added to our knowledge as to the calcium content of the arterial wall from its chemical aspect. Selig's paper (Hoppe-Seyler's Zeitschr. f. Physiol. Chem., Vol. LXX (1911) p. 451) deals with analyses of but a small number of aortas, but gives much more clinical detail than Gazert did, and includes elastin in some of the analyses. Amaser continued Selig's researches but, like Selig, came to no helpful conclusions.

It is not always easy or possible to compare the results of different observers on the calcium content of tissues, because there is no uniformity in the method of stating them. Some give their figures in terms of Ca , some in terms of CaO ; some give the percentage of calcium in fresh, others in dried tissue. It is much to be desired, as Albu and Neuberg have urged, that all results should be stated in terms of CaO , and it seems better to give them as percentages of tissue dried to constant weight. I have done this throughout the present investigation, as Gazert did. The methods of estimating calcium in tissues for a long while left much to be desired, and many of the results of older observers are doubtfully comparable with modern ones: it is only recently that fairly reliable methods have been devised, *e.g.*, that of Aron (1908).

The majority of those who have worked at the subject were essentially chemists investigating pathological material, and to most of them an aorta was either "normal" or "atheromatous." Their writings are for the most part little concerned with the clinical aspect of the cases which they studied, or with the histology of their material, and though laborious and doubtless accurate, they are of more interest to the chemist than to the clinician. But if chemical analyses are to be of practical service in the study of disease they need to be brought into close touch with morbid anatomy and histology and, above all, with clinical history. It therefore appeared that there was not only room, but a real need, for a series of chemical

analyses of arteries which should be correlated with clinical facts more closely than has hitherto been attempted.

Since the task is a heavy one I have been obliged to limit it. The only artery I have analysed has been the aorta, for it is the only vessel of sufficient bulk for chemical investigation in those lesser degrees of calcareous change which it seemed especially important to study. Indeed, in normal vessels up to 20 years of age, single aortas are insufficient, and I have had to mass a number of them to get enough calcium for accurate estimation. The only chemical data studied have been the ash-percentage of the dried vessel and the CaO percentage of the ash and dried solids, together with sundry side issues to which allusion will be made in due course.

The research was designed and carried out by myself, but I had to go to school and learn the methods from my chemical colleagues. I desire to express my deep debt, first to Mr. Mackenzie Wallis, Pathological Chemist to St. Bartholomew's Hospital, who taught me the methods required and was at all times ready with advice and assistance, and in the next place to Dr. W. H. Hurtley, Lecturer on Chemistry at St. Bartholomew's, who also helped me with many suggestions, and who has just devised a new method of estimating calcium in tissues, perhaps simpler and quicker than that which I have used. With such skilled assistance at my back I believe I may affirm my results to be chemically trustworthy.

The total number of aortas dried and analysed in this research has been 91. Of these, 53 have been completely analysed, and five as regards the ash only, while 33 have been massed aortas at different ages, analysed in six separate series.

METHODS EMPLOYED.

Clinical data.—Almost without exception the material used was from the post-mortem room of St. Bartholomew's Hospital, though in one or two instances it has been from other sources. I had, therefore, at my command fairly full details as to the history of most of my cases, though some were brought dead or moribund to the hospital, so that little could be ascertained about them. In all instances I have obtained the fullest clinical details available and these have been supplemented when necessary by histological examination and by the employment of Wassermann's reaction on the blood after death, with a due appreciation of its limitations under such circumstances.

Preparation of material.—The material employed was the aorta, often with attached portions of some of its great branches (carotids, iliacs, &c.). As a rule, the entire aorta, from its origin to its bifurcation, has been taken: sometimes only a portion of the vessel was available.

I found it important that the vessel should be dried straight from the body. If it is kept in any preserving fluid changes occur with great rapidity in the mineral constituents. I discovered this owing to anomalous results from arteries procured for me by the kindness of friends and kept in 10 per cent. formalin for a day or two. I put the matter to the proof thus: a fresh aorta was divided longitudinally into two equal halves; one was dried at once and the other kept for 48 hours in 10 per cent formalin. The halves were then separately analysed. In each of two cases analysed, one by myself and the other, by a different method, by Dr. Hurtley, the same phenomena were observed. In the half preserved in formalin the total ash was

diminished, owing to diffusion of the more soluble mineral constituents : but the actual amount of calcium was increased owing to adsorption from the formalin, which was found to contain calcium salts in noteworthy amount. The figures are as follows :—

	Case 1.		Case 2.	
	Half dried direct.	Half kept in formalin.	Half dried direct.	Half kept in formalin.
Percentage of ash in dried solids.	3·12	1·47	5·31	4·24
Percentage of CaO in ash ...	11·56	36·24	29·97	52·66
Percentage of CaO in dried solids.	0·36	0·55	1·59	2·33

It is plain from these figures that analyses on vessels which have been preserved in any sort of fluid must be untrustworthy, on account of loss of soluble mineral elements, and also that the tissues of the arterial wall are very avid of calcium. I was so surprised by the above results that I instituted a further set of experiments to determine more precisely the calcium avidity of the arterial wall, and of its main component tissues, for this may have a much wider bearing than the mere invalidation of chemical analyses.

A solution of calcium chloride was prepared of a strength of 1·25 per cent. in distilled water. I divided a fresh aorta into two longitudinal halves, dried one half direct, and put the other into the CaCl_2 solution, with some crystals of thymol to check putrefaction. I obtained also from the slaughterhouse fresh tissues from a young bullock, viz, the ligamentum nuchæ, the tendo Achillis and a few feet of intestine. From the latter I dissected away the peritoneal and mucous coats leaving a pretty pure sheet of unstriped muscle. I had thus the three main ingredients of the arterial wall, elastic tissue, white fibrous tissue and smooth muscle : I could not have obtained them all in sufficient bulk from human sources. Each tissue was divided into two approximately equal portions, of which one was dried direct and the other placed, with a little thymol, in the CaCl_2 solution. All the tissues were left 10 days in the calcium solution. They were then washed and massaged in warm tap-water to get rid of any surface deposit of lime, and finally soaked in several changes of distilled water, the muscle for one hour, the other tissues for three or four hours, to allow any unfixed calcium chloride to diffuse away. They were then dried and analysed. The results of the experiment were as follows :—

(1) HUMAN AORTA :

	Dried direct.	After 10 days in CaCl_2 .
Ash, per cent. of dry solids ...	3·62	2·74
CaO, per cent. of ash ...	25·51	57·01
CaO, per cent. of dry solids ...	0·92	1·56

(2) UNSTRIPED MUSCLE OF OX :

	Dried direct.	After 10 days in CaCl_2 .
Ash, per cent. of dry solids ...	3·17	2·71
CaO, per cent. of ash ...	8·88	36·25
CaO, per cent. of dry solids ...	0·28	1·06

(3) ELASTIC TISSUE OF OX :

	<i>Dried direct.</i>	<i>After 10 days in CaCl₂.</i>
Ash, per cent. of dry solids ...	0.609	0.66
CaO, per cent. of ash ...	7.76	66.25
CaO, per cent. of dry solids ...	0.047	0.44

(4) WHITE FIBROUS TISSUE OF OX :

	<i>Dried direct.</i>	<i>After 10 days in CaCl₂.</i>
Ash, per cent. of dry solids ...	0.83	0.99
CaO, per cent. of ash ...	5.87	80.66
CaO, per cent. of dry solids ...	0.048	0.804

Put in another way the facts may be stated thus :

100 grammes of dry aorta tissue had adsorbed	0.649	gms. CaO.
" " ox muscle	0.783	"
" " elastic tissue	0.395	"
" " white fibrous tissue had		
adsorbed	0.756	"

The human aorta, which already contained a good deal of lime, had only increased its calcium content by some 60 per cent., but the ox muscle had increased its lime nearly 4-fold, the elastic tissue nearly 10-fold and the white fibrous tissue nearly 17-fold.

These facts were merely a side issue in the present investigation, and I had no time to pursue them further. They prove that the arterial wall, as a whole, and also its three chief component elements, readily take up calcium in large amount, as dead tissues. The subject might be worth pursuing, since the degenerate and dying cells in the wall of the living artery seem similarly associated with the deposition of calcium from the lymph- or blood-stream. I am unaware that the phenomena of arterial calcification have been approached from this aspect of the question.

With apologies for this digression, I return to the preparation of the material for analysis. In all cases the aorta was cleaned by snipping off all adherent tissue with scissors. There is no definite outer limit to the adventitia, so that one cannot say where the artery leaves off and the sheath begins, but I can assert that the tissue I analysed was essentially arterial wall only.

The cleaned fresh vessel was now cut up with scissors into small pieces and dried to constant weight. At first I used drying in vacuo over sulphuric acid, but this method proved a bad one, for the more perfect the vacuum, the less did the tissue dry. My apparatus was at first imperfect and the tissue dried fairly well, but when the pump and joints were so improved as to ensure a good vacuum, lasting many hours, drying became impossible. This paradoxical result proved due to the fact that the vacuum was so good as to permit of the growth of anaërobic bacilli, necessarily present in post-mortem room material: the putrefactive products thus arising were so hygroscopic as to hinder desiccation and the whole mass became moist and stinking.

The method of drying finally adopted was the steam-oven at 90° to 95° C., with or without a preliminary drying on a water bath. The material was placed in a weighing bottle holding 10 or 12 grammes. Two or three days in the steam-oven usually reduced it to constant weight: only in the case of very fatty and degenerate vessels was a longer period needful. The weighing was conducted on a balance accurate to a tenth of a milligramme.

Incineration.—When the weight was constant the material was ashed in a platinum dish. I tried silica dishes, but they were too readily attacked by the alkali in the ash. Even platinum is somewhat attacked, and I found it needful to weigh the dish scrupulously before and after each incineration. The burning was conducted over a Meker burner, finishing off with the blowpipe in obstinate cases. It was impossible to avoid some loss of alkaline chlorides, which were driven off when the blowpipe was used and even to some extent by the Meker burner. This makes the ash percentage a little unreliable, but does not affect the calcium.

Calcium estimation.—This was carried out in all cases by Aron's method, slightly modified. In this method, introduced some six years ago and now widely used, the calcium is obtained in the form of sulphate by boiling with strong sulphuric acid, and precipitated with alcohol. While this method is a very useful one it is subject to certain fallacies and requires strict control. Other sulphates are liable to be thrown down if the alcohol percentage be too high. In the presence of 70 per cent. alcohol, as in Aron's original method, magnesium sulphate is apt to be thrown down, and even sodium sulphate. On the other hand, if the alcohol percentage be too low all the calcium sulphate may not be precipitated. The best strength is 50 per cent. alcohol—in which the sodium and magnesium sulphates remain in solution, while all but traces of the CaSO_4 are thrown down. The precipitates were repeatedly tested in the course of my analyses, and no magnesium was ever found, except a trace on one occasion only. It is probable that Aron's method, as I used it, slightly underestimates the amount of calcium present, as I shall show directly.

The precipitate of CaSO_4 should be amorphous and flocculent; when it is visibly crystalline the flask should be heated on a water-bath and then allowed to reprecipitate in the cold. In such cases either magnesium may be present or the calcium sulphate may have come down in the hydrated form with two molecules of water, introducing an error in weighing.

The exact details of the method I employed were as follows: The ash was washed down with a little hot distilled water into a Kjeldahl flask and cooled. Ten c.c. of strong H_2SO_4 were then gradually added and the material put to boil in a fume cupboard. When all the water and some of the acid had boiled off, there commonly remained a clear solution, colourless when cold: if much calcium was present and especially if there were hard calcareous plates in the ash, more sulphuric acid had to be added and the boiling repeated. When solution was complete the mixture was cooled and diluted five- or six-fold with water; it was cooled again, and an exactly equal volume of absolute alcohol added. The precipitation was conducted in a flat-bottomed flask and often took some time. After 24 hours the precipitate was collected on a Gooch crucible, washed twice with fifty per cent. alcohol, twice with absolute alcohol, and then dried in the steam oven, and weighed when cool. The figures were then converted into terms of CaO . I believe that the data thus obtained have been accurate: certainly no pains have been spared to make them so.

While my work was going on Dr. W. H. Hurlley devised a new method of determining calcium in tissue ash and other material, which he is now publishing. The novel feature of this method lies in the use of warm phosphoric acid for the solution of the ash.

The calcium is then precipitated as oxalate by the cautious addition of potassium oxalate, and after washing, titrated with permanganate in the usual way. This method is not only, as Dr. Hurtley has shown by a large number of experiments and controls, a very accurate one, but is much more speedy than Aron's. On two occasions the methods were compared, an aorta rich in lime salts being longitudinally divided as equally as possible. I did one half by Aron's method, while Dr. Hurtley used his method on the other. The results were these :—

	Case 1.		Case 2.	
	Aron's method.	Hurtley's method.	Aron's method.	Hurtley's method.
Ash percentage of dry solids ...	5·056	5·076	14·61	14·84
CaO percentage of ash ...	25·53	25·79	51·007	54·30
CaO percentage of dry solids ...	1·29	1·31	7·45	8·06

These results are as close as could be expected in the partition of a vessel not uniformly calcified. In both cases the titration method gives somewhat higher results than precipitation and weighing.

GENERAL CONSIDERATIONS AS TO LIME SALTS IN THE ARTERIAL WALL.

Before I set out the results I have obtained it will be well to consider the nature of the information to be derived from chemical analysis and its obvious limitations. From a physiological point of view chemical analysis is a gross method. It can tell us the exact percentage of calcium in an artery, but nothing of the finer combinations in which that calcium was held during life.

The lime salts of the body fall under different physiological categories :—

- (1) Every tissue contains a certain amount of calcium, usually minimal in amount, but presenting some sort of correspondence with the physiological activity of the tissue in question. But in normal tissues no calcareous material is microscopically recognisable ; the lime seems to be an integral element of the active tissue—one of the essential constituents of living protoplasm, and possibly present in the ionic condition. We may fairly term this living form "*vital calcium*" and regard it as normal and essential to tissue activity.
- (2) One of the connective tissues, namely bone, makes use of the physical properties conferred by the presence of insoluble lime salts, and by its affinity for calcium attains firmness and rigidity. It is stated that the bones contain 99 per cent. of the total calcium in the normal body. (Albu and Neuberg).
- (3) In a third form, calcium is apt to be deposited in certain tissues in a non-ionic and relatively insoluble form, serving no apparently useful purpose and sometimes hampering the functions of the organ concerned. Such

deposit does not occur in active living tissues, but in those which are moribund or necrotic, and as a rule it takes place less in the cells themselves than in the intercellular material. Good examples of this "*rubbish-heap*" calcium, as it may be termed, are furnished by the calcification of senile cartilage, and of old tuberculous foci in which infection has been overcome. It must be assumed that, in these dead-alive places, chemical substances are present having such strong affinities for calcium as gradually to fix it, from the scanty amount normally present in the blood or lymph, till the accumulation becomes a copious and visible one.

Of this nature probably are the calcareous changes found in arterial degeneration. It may be argued, with some plausibility, that there is a useful purpose in such calcareous deposition, and that the rigidity conferred is of service in strengthening the decaying vessel. It is possible that there is some truth in such a contention: calcification may prevent over-distension and aneurysmal dilatation, but it hinders one of the main functions of an artery—that of regulating the blood flow by varying its calibre. On the whole the strong analogy between the process as seen in arteries on the one hand, and in other degenerating tissues, where no such conservative aim can be invoked, on the other, seems opposed to this notion.

In the chemical analysis of an artery the amount of calcium found is the sum of two forms of the element. Some of it is "living" ionic calcium from the active protoplasm of the tissues; the rest is "dead" rubbish heap calcium deposited amongst the *débris* of the cells as these have fallen into decay. Further, corresponding with the two commoner forms of arterial degeneration—primary calcification of the middle coat and nodular sclerosis of the intima—the calcium found on analysis may have come chiefly from the middle coat, or chiefly from scattered foci in the intima.

Concerning these important data chemical analysis is dumb, and we must seek our information in other ways: as a rule the morbid anatomy and histology of the vessel allow of reasonably safe conclusions. This is why, as I have previously remarked, chemical analysis must always be interpreted in connection with clinical history and morbid anatomy. If we do this, and bear in mind the necessary limitations of chemistry, analysis yields information of a very valuable kind.

If the lime salts were uniformly distributed throughout the wall of a degenerate artery I believe that we should have, in the CaO percentage of its dried solids, a reasonably accurate measure of the degree of degeneration. But there are two circumstances which prevent our taking it as an absolute measure. One is the local character of nodular sclerosis, in which there are often one or two fully calcified patches in an otherwise almost normal vessel. These so raise the calcium content of the vessel as a whole, as to vitiate the chemical data derived from a total analysis. The second lies in the peculiar behaviour of syphilitic arteries, which commonly exhibit advanced degenerative change with no corresponding increase in the lime-salts. In spite of these drawbacks, I believe, as the result of my observations, that if we recognise the limitations which they impose, the CaO percentage of the arterial wall offers a useful index of degeneration.

THE CALCIUM-CONTENT OF THE NORMAL AORTA.

In attempting to set up a calcium standard by which to judge the degenerate artery it is plain that the first step is to ascertain the calcium content of the normal vessel, and this for all age periods. Except for Gazert's analysis of 12 normal aortas at ages ranging from 17 to 48, I know of no attempt to set up such a standard, and it requires to be based on a large number of analyses. A very large part of the work which I have carried out has therefore been devoted to the analysis of normal vessels, of which I collected 50, though one or two had later to be excluded. Only 17 of these were analysed singly, the rest were grouped in age periods for two reasons. In children and adolescents up to the age of 20 the amount of calcium present is so small that I could not accurately weigh it from individual aortas. I therefore dried and stored the aortas from different age periods till I had enough material for accurate estimation. From 20 to 40 years of age it is easy to obtain truly normal aortas, and they contain enough calcium for individual analysis, but above the age of 40 it is almost impossible to find really normal vessels, for arterial decadence has now commenced. Such wide differences were found in the calcium-content of different apparently normal vessels, that I feared the introduction of a personal element of selection in constructing my calcium curve. I therefore adopted a suggestion made to me by Dr. C. J. Martin, and picked out the most normal arteries I could find at the higher age periods, dried them and weighed out 2 grammes from each to form a type-mixture for a particular decade. In this way I secured five aortas from the fifth and five from the sixth decade, representing the best vessels obtainable at these age periods. Above the age of 60 I have only a few individual analyses of vessels which seemed unusually good for their age.

In selecting aortas for this "normal" series, I have adopted two criteria. Only those vessels have been taken which appeared natural to the naked eye, as regards thickness, elasticity and absence of local foci of sclerosis. Further, I have rejected even apparently normal vessels when the patient has died of chronic wasting disease, or of any condition liable to cause arterial degeneration, *e.g.*, chronic nephritis. Most of my cases have been persons cut off in full health by a violent death or by an acute illness of short duration. I have not excluded from the normal series cases presenting trivial fatty streaks in the intima, for these are so common as to be almost universal.

The data obtained have been as follows:—

(1) *The Calcium-content of the Aorta in Childhood and Adolescence.*

(a) I have no figures for the aorta at birth. I attempted to analyse that of an infant two days after birth, but I obtained only $1\frac{1}{2}$ milligrammes of ash, which represented 0.309 per cent. of the dry solids. As the ash-percentage in the second year of life is 1.4 it may be inferred that the CaO percentage is considerably less at birth than a year or two later.

(b) A collection of aortas, all natural to the naked eye, was made from 11 children of two years old and under. The cases were as follows:—

No.	Sex.	Age.	Cause of death.
1	Male ...	16 months ...	Tuberculous meningitis.
2	Male ...	11 months ...	Empyema, rickets.
3	Male ...	17 months ...	Diarrhœa and vomiting.
4	Male ...	15 months ...	Pneumococcal arthritis and meningitis.
5	Female ...	18 months ...	Diphtheria.
6	Female ...	19 months ...	Broncho-pneumonia.
7	Female ...	7 months ...	Diarrhœa and vomiting.
8	Male ...	2 years ...	Scalds.
9	Male ...	16 months ...	Diarrhœa, vomiting, bronchitis.
10	Male ...	2 years ...	Broncho-pneumonia.
11	Male ...	7 months ...	Broncho-pneumonia.

The average age of these cases is 15·8 months. The figures on combined analysis will be found in the table shortly following.

(c) A similar collection was made from six children of 8 to 10 years old, in all of whom the aorta appeared normal. The cases were these :—

No.	Sex.	Age.	Cause of death.
1	Female ...	10 years ...	Fractured spine.
2	Male ...	10 years ...	Tuberculous meningitis.
3	Male ...	9 years ...	Broncho-pneumonia.
4	Male ...	8 years ...	Cerebellar abscess.
5	Male ...	8 years ...	Tuberculous meningitis.
6	Male ...	9 years ...	Pneumonia.

The average age of these cases is 9 years.

(d) Four aortas were collected from the second decennium of life, as follows :—

No.	Sex.	Age.	Cause of death.
1	Male ...	15 years ...	Tuberculous meningitis.
2	Male ...	17 years ...	Death after operation for hernia.
3	Female ...	19 years ...	Cerebellar abscess in otitis.
4	Female ...	16 years ...	Mitral stenosis—epilepsy.

The average age of these cases is $16\frac{3}{4}$ years.

The figures for childhood and adolescence are seen in the following table :—

TABLE OF ASH- AND CaO-CONTENT OF NORMAL AORTAS IN CHILDHOOD AND ADOLESCENCE.

Average age.	Weight of dried aortas, in grammes.	Weight of ash, in grammes.	Weight of CaO obtained, in grammes.	Ash percentage of total solids.	CaO percentage of ash.	CaO percentage of total solids
11 cases—average 15·8 months.	12·0132	0·1688	0·0136	1·405	8·06	0·113
6 cases—average 9 years.	15·7982	0·2465	0·0178	1·56	7·28	0·113
4 cases—average $16\frac{3}{4}$ years.	15·2349	0·2408	0·0177	1·58	7·43	0·117

It may be concluded from these figures that the calcium content of the aorta in the growing child is small and constant. The rise at puberty is very slight, and what is true of the calcium holds for the ash as a whole. There is no suggestion of any pathological calcareous deposit in these young vessels, and the calcium is presumably in the "vital" condition as an essential constituent of the living tissue.

(2) *The Calcium Content of the Aorta in Young Adult life and Early Maturity.*

By 20 years of age a single aorta can easily be analysed, and for my figures for the third and fourth decades of life I rely upon such individual analyses.

(a) *The third decade.*

I analysed six cases between 20 and 30 in whom the aorta appeared normal, but I base the average for this decade on three only.

Case 1.—Male, age 24. A motor fitter, of great muscular development, given to bicycling. Heart 14 oz. Kidneys normal. Death resulted from a fractured skull.

Case 2.—Male, age 27. Wharfside labourer. A very powerfully built man. Heart 15 oz. Kidneys normal. The aorta showed a single circumscribed plâque of early sclerosis, not syphilitic (see Part I. of this report, case 37). Death was from a fractured skull.

Case 3.—Male, age 26. Death was from shock following trephining for epilepsy. The aorta appeared absolutely normal.

The figures for these three cases are seen in the following table:—

TABLE OF ASH- AND CaO-CONTENT OF NORMAL AORTAS IN THIRD DECADE OF LIFE.

Case.	Age.	Weight of dried aorta, in grammes.	Weight of ash, in grammes.	Weight of CaO obtained in grammes.	Ash percentage of total solids.	CaO percentage of ash.	CaO percentage of total solids.
1	24	7.614	0.1505	0.0176	1.97	11.74	0.232
2	27	6.701	0.1234	0.0163	1.84	13.25	0.244
3	26	4.671	0.104	0.0132	2.22	12.72	0.283

It is seen that the figures in the last column are very close. The average is 0.253 per cent. CaO at 25 years of age.

The other three cases examined in this decade yielded figures so much higher and lower than this that I cannot deem them normal. One was a wasted and ill-developed girl of 20, who died of cerebral abscess following otitis media. The aorta looked normal, but the dried solids yielded only 0.069 per cent. CaO—a result lower than that yielded by my series of infants. I cannot explain this case. The heart, uterus and voluntary muscle yielded a CaO percentage not far removed from that of the aorta.

The remaining two were cases mixed and analysed together, so that I do not know which was at fault. One was a woman of 25, accidentally suffocated by vomiting, the other, a man of 23, who

committed suicide by taking corrosive sublimate, lingering nine days. The CaO percentage of the dried solids of the mixed aortas was 0·386, a figure comparable with that obtaining in the next decade. I suspect that the calcium metabolism of the corrosive sublimate case may have been disturbed; he had an excess of calcium salts in the kidney.

Even if I include these three cases in the normal series they almost average each other out. The average for the six cases is 0·266 per cent. as against the 0·253 per cent. of the cases I have selected.

Gazert analysed 4 separate aortas from this decade—all approximately normal. His average is higher than mine, viz., 0·35 per cent. CaO for an average age of 25·5 years—a difference perhaps due to the different method of analysis he employed, perhaps to a less strict conception of the “normal.” His extremes are 0·25 and 0·53 per cent.

(b) *The Fourth Decade.*

I have analysed 5 normal aortas from adults dying between 30 and 40, all cases which seem beyond reproach, and yielding very consistent results.

Case 1.—Female, age 30, 8 months pregnant. Died after Cæsarean Section. Heart and aorta normal.

Case 2.—Male, age 32. Death from general peritonitis following a perforated gastric ulcer. A few fatty streaks in intima of aorta.

Case 3.—Male, age 32. Suicide with revolver. Heart and kidneys normal. Aorta showed some fatty intimal changes.

Case 4.—Female, age 34. Death from fractured skull. Heart, kidneys, and aorta quite natural.

Case 5.—Male, age 37, a bank clerk. Died of fractured skull eleven or twelve days after a taxi-cab accident. Heart 12 oz. Aorta normal.

The figures for these 5 cases are as follows :—

TABLE OF ASH AND CaO CONTENT OF NORMAL AORTAS IN FOURTH DECADE OF LIFE.

Case.	Age.	Weight of dried aorta, in grammes.	Weight of ash, in grammes.	Weight of CaO obtained, in grammes.	Ash percentage of total solids.	CaO percentage of ash.	CaO percentage of total solids.
1	30	5·1807	0·1186	0·02005	2·29	16·91	0·387
2	32	4·475	0·140	0·0162	3·12	11·56	0·361
3	32	6·833	0·1429	0·0217	2·25	15·24	0·318
4	34	7·529	0·1748	0·0281	2·32	16·08	0·373
5	37	4·760	0·1135	0·0187	2·384	16·48	0·393

As in the third decade the figures in the last column of the table are very uniform, and indicate an average of 0·366 *per cent.* CaO in the dried solids—at the *age of 33 years*—which is the mean of these five cases.

Gazert gives figures for two normal aortas in this decade—one at 30 years with 0·52 per cent. CaO, and one at 28 years with 0·67 per cent. As in the previous decade his figures are a good deal higher than mine.

3. *The Calcium Content of the Aorta after the Age of 40 Years.*

In my previous report I pointed out that the closing years of the fourth decade of life marked the termination of the full physiological activity of arteries. This conclusion, reached on clinical, physical, and histological grounds, is strongly supported by the chemical figures I shall next have to relate. A sudden change sets in about the fortieth year, in virtue of which lime salts are deposited in the arterial wall in greatly increased amount. Never again (except in syphilitics, who form a class apart) are such low figures to be found as I have thus far recorded.

This chemical fact is but the reflection of an anatomical one, for after 40 some degree of disease or degeneration in the arteries is practically invariable, but extremely irregular in its incidence. There is no "normal" in the youthful sense—only an average of abnormality. Individual differences become more striking, even if one selects only cases which show what may be deemed the reasonable wear and tear of life. I have separately analysed eight cases after 40 in which the aorta showed so little change that it would pass for almost normal. I found it difficult to base satisfactory averages on these, so I set to work to collect vessels at different age-periods, as already stated. These were all selected arteries, representing the best that could be found at that age, though some had commencing sclerosis. It is not easy to find cases in which not only is the aorta in relatively good condition, but in which the heart and kidneys are normal, and syphilis, alcoholism, &c., excluded as far as possible. It took several months to get five such vessels from each of the fifth and sixth decades. Above the age of 60 I have only one or two isolated cases.

Five Cases of Relatively Normal Aortas from the Fifth Decade.

- Case 1.*—Male, age 41. Died of perforated gastric ulcer and peritonitis. Heart and kidneys natural. Aorta almost normal, but showed two early islands of nodular sclerosis without calcification.
- Case 2.*—Male, age 40. A platelayer killed on the railway. Aorta looked normal to the naked eye.
- Case 3.*—Male, age 46. Death from cancer of stomach. The aorta looked quite normal to the naked eye.
- Case 4.*—Female, age 43. Death from pneumonia following the operation of hysterectomy. The aorta appeared normal.
- Case 5.*—Female, age 46. Death from subphrenic abscess following perforation of a gastric ulcer. Ill one month. Aorta almost normal; one tiny, half calcified nodule just above the bifurcation, not included in the part taken for analysis.

The average age of these cases is 43.2 years. The aortas were dried separately, and two grammes weighed out from each, mixed and analysed as a single sample.

Five Cases of Relatively Normal Aortas from the Sixth Decade.

- Case 1.*—Female, age 55. Death from appendicitis and subphrenic abscess. Heart and kidneys normal. The aorta showed some intimal fatty changes, but appeared otherwise normal.

Case 2.—Male, age 57. Carcinoma of colon, peritonitis, sub-phrenic abscess. Heart and kidneys normal. Aorta fairly good in its thoracic portion, which was that taken for analysis; the abdominal aorta was more degenerate and presented one atheromatous ulcer but hardly any calcification.

Case 3.—Female, age 56. Intestinal obstruction from gangrenous appendicitis. Only the thoracic aorta was taken for analysis; it showed some fatty change in the intima, and there were one or two nodules of sclerosis, but no visible calcification. The abdominal aorta was more degenerate than the thoracic.

Case 4.—Male, age 54, dead of a malignant mediastinal growth. The aorta was normal to the naked eye.

Case 5.—Male, age 50, dead of malignant endocarditis (pneumococcal). The aorta was normal to the naked eye.

The average age of these cases is 54·6 years. As with the preceding decade 2 grammes were weighed from each dried aorta and mixed for analysis.

Seventh decade.

Only one suitable case could be found from this decade. This was a stout woman, said to have had the habit of drinking. Her age was 63. She died of carcinoma of the breast with secondary growths in the liver and suprarenals. The blood pressure was low during life (105 mm. Hg.) and the heart weighed only 8 oz. The aorta was thick, but presented no nodular sclerosis; there was no evident calcification except for a little plate at the scar of the ductus arteriosus.

Eighth decade.

Here again only one suitable case was found. This was a cabman, age 72, who fell off his cab and fractured his skull. The heart weighed 14½ oz. The kidneys showed slight senile sclerosis. The aorta was in singularly good condition: it presented some intimal thickening but no "atheroma." There were two small calcareous patches visible, which were excluded from analysis.

The analyses of these approximately normal vessels, after 40, which are those I have used in constructing my "normal calcium curve," are shown in the following table:—

TABLE OF ASH AND CaO CONTENT OF APPROXIMATELY NORMAL AORTAS AFTER THE AGE OF 40 YEARS.

Decade.	Average age.	Weight of dried aorta, in grammes.	Weight of ash, in grammes.	Weight of CaO obtained, in grammes.	Ash percentage of total solids.	CaO percentage of ash.	CaO percentage of total solids.
Fifth ...	43·2	9·9608	0·441	0·1085	4·42	24·604	1·09
Sixth ...	54·6	9·9015	0·578	0·1665	5·84	28·77	1·68
Seventh	63	8·8606	0·536	0·1787	6·019	33·35	2·017
Eighth..	72	8·831	0·581	0·2147	6·579	35·95	2·43

THE NORMAL CALCIUM-CURVE FOR ALL AGES.

It remains to summarise the results of the chemical analyses of the 41 normal, or approximately normal aortas, which I have detailed above, by plotting them in graphic form, so far as concerns the data in the final column of each table, viz., the CaO content of the dried solids.

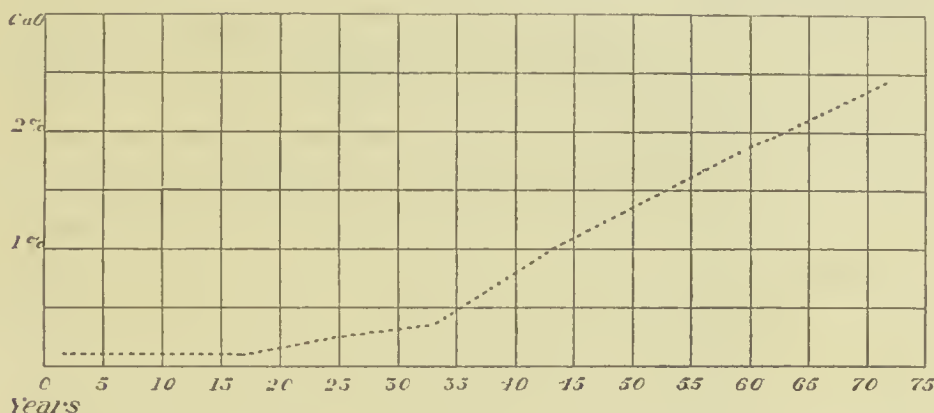


CHART OF THE NORMAL CaO CONTENT OF THE AORTIC WALL FOR ALL AGES—
Based on 41 vessels.

I venture to hope that the curve depicted above represents a real advance in our knowledge as to the calcareous changes in arteries. It has taken a year to collect the material for its construction, and the task has not, I believe, been previously attempted on this scale. I have given sufficient detail as to the material on which it is based to allow of criticism. If it be accepted, as I think it may, as a fair representation of the natural course of events, the curve gives us, for the first time, a standard by which we may judge abnormal vessels, as I shall presently attempt to do.

Let me, however, first call attention to certain features of the curve. It is necessarily based on my own personal conceptions of what constitutes a "normal" aorta for the different age-periods, and I could wish that for the later decades a larger number of cases had been available. Although I have met, in advanced age, with instances of a lower calcium content than is suggested by the curve, I think they are exceptional, and I believe that the curve represents very fairly the average course of events under favourable conditions as regards arterial efficiency. It shows the amount of CaO which a person is entitled to have in his aorta in virtue of his age and thus enables us to judge whether the actual amount found under given conditions demands a special explanation.

The age-periods on which I have constructed the curve are perhaps too wide apart at certain ages, so that the curve is here unduly flattened out. My impression, derived from individual analyses, is that it should rise more abruptly at 20 years and at 40 years than the diagram indicates. Thus, to take the last named critical age, reference to the figures given for 5 analyses of separate normal arteries in the fourth decade will show that they are very uniform and that the latest of them, which was also the highest in calcium, gave only 0.393 per cent. CaO. This was at 37 years. The curve for this decade should be almost flat. Now, besides the massed five aortas which I have taken for the normal of the fifth decade, and which already show an average of 1.09 per cent. CaO at

43 years, I have analysed five separate normal aortas at this age period for which I will now give the figures.

The cases are these :—

Case 1.—Male, age 41. Died of streptococcal septicæmia following cellulitis of arm. Heart 14 oz. normal. Kidneys normal. Aorta normal, except for fatty streaks in intima.

Case 2.—Female, age 42. Death after decompression operation for an endothelioma of the brain. Heart and kidneys normal. Aorta normal, except for trivial fatty specks in intima.

Case 3.—Male, age 42. All organs normal. Aorta almost normal, but showed a few spots of commencing nodular sclerosis at the origins of the great vessels of the neck. Death was from streptococcal septicæmia in mastoid disease.

Case 4.—Male, age 45. Died of pneumonia following burns sustained owing to setting fire to his celluloid collar in attempting to light a cigarette while in an intoxicated condition. All organs, except the lungs, were normal. The aorta showed early traces of nodular sclerosis at the root and above the bifurcation, elsewhere it was normal.

Case 5.—Female, age 46. Death from intraperitoneal hæmorrhage, the day after a hysterectomy for fibroids. The heart weighed $12\frac{1}{2}$ oz. and the kidneys were very slightly granular. The aorta presented a few areas of early nodular sclerosis about the arch, but was otherwise natural.

The analyses of these five cases were as follows :—

TABLE OF ASH AND CaO CONTENT OF INDIVIDUAL APPROXIMATELY NORMAL AORTAS IN THE 5TH DECADE.

Case.	Age.	Weight of dried aorta, in grammes.	Weight of ash, in grammes.	Weight of CaO obtained, in grammes.	Ash per centage of total solids.	CaO per centage of ash.	CaO per centage of total solids.
1	41	10.434	0.389	0.0972	3.73	24.94	0.932
2	42	6.758	0.263	0.0566	3.90	21.501	0.838
3	42	7.910	0.330	0.0996	4.17	30.15	1.26
4	45	4.511	0.163	0.0417	3.62	25.51	0.924
5	46	3.394	0.261	0.0419	3.116	16.02	0.499

The average age of these five cases is identical with that of the five massed aortas from this decade, viz., 43.2 years. The average CaO content is a little lower, viz., 0.8906 per cent. as against 1.09 per cent., owing to the inclusion of an abnormally low figure in Case 5: if this be excluded the average is 0.988 per cent.—almost identical with that of the massed cases. It will be noted that this low figure is from a female case, and I believe it true that the average calcium content at any given age tends to be lower in the female than in the male, just as on clinical grounds it is held that arterial degeneration is on the whole later in its incidence on the female sex.

But the point brought out by these figures is the *sudden* rise in calcium content about the age of 40 years. Whereas the highest normal figure for the thirties was below 0.4 per cent. CaO we already

find in the earliest forties figures approaching 1 per cent. The calcium in the aortic wall seems doubled, if not trebled, in the course of three or four years. It would of course take a larger series of cases than I am here able to present, to prove this point conclusively.

I regret that I have not a sufficient number of cases about the age of 20 years to prove any sudden rise here too, corresponding with the cessation of bony growth, though I incline to believe that something similar might also be found at this critical period.

The facts are more effectively shown in graphic form, and I have therefore plotted out in the subjoined chart the calcium figures for all the normal aortas separately analysed during the 3rd, 4th, and 5th decades.

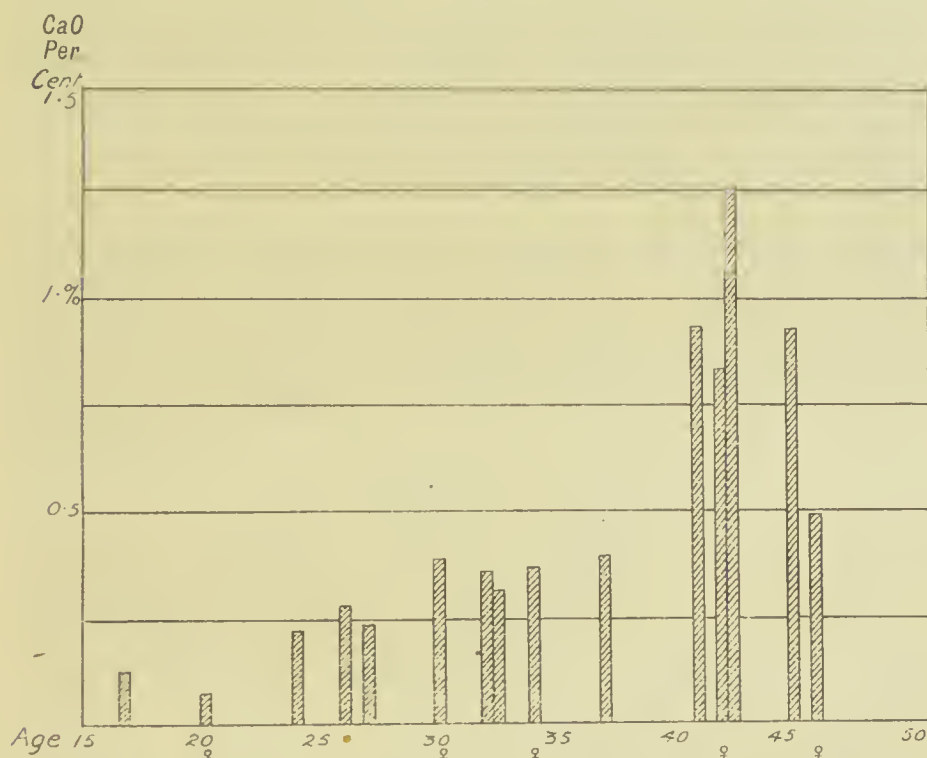


Chart showing the *CaO* percentage of the dried solids of the aorta in all the normal vessels analysed separately, in the 3rd, 4th and 5th decades of life. (The sign ♀ is placed below the female cases.)

The suddenness of the jump at 40 is very obvious, coinciding with the commencement of arterial decadence. The two lowest figures after 40 are seen to be in women, as is the abnormally low figure at 20.

SUMMARY AND CONCLUSIONS AS REGARDS THE CALCIUM CONTENT OF NORMAL AORTAS.

The facts which I have set forth above suggest the following conclusions. As has been independently concluded on quite other grounds, so also from the calcium figures the life history of an artery falls into three periods, those of adolescence, maturity, and decay.

(1) During childhood and up to the age of 20 years the percentage of *CaO* in the dried vessel wall is low, being scarcely more than

0.1 per cent., and it is very constant, being little higher at 16 or 17 than in infancy. It may be assumed that the calcium at this age is all in the living or ionic condition, and represents the minimum required for the effective working of the tissues in the vessel wall. We know that during the period of growth there is an immense drain upon the calcium resources of the body for building up the bony skeleton.

(2) With the cessation of growth there is less need for this economy of calcium, and the mature artery finds its needs, which are doubtless somewhat greater than in the child, readily met. Nor are its requirements very large; a percentage of CaO lying between 0.2 and 0.4 seems fully adequate for the work of the aorta even in a well developed labourer. During the whole period of maturity the calcium curve is a very flat one, much flatter than the curve constructed from the averages at different decades would suggest, as is shown by the graphic chart of individual arteries. There is a slight rise, for whereas in the twenties the average CaO percentage is a little below 0.3, in the thirties it lies nearer 0.4 than 0.3. There is still nothing to suggest that this calcium is other than in the "vital" condition, bound up with the tissue proteins.

(3) Suddenly, at about the age of 40, the calcium begins to rise rapidly and in a year or two approaches, or reaches 1 per cent. CaO in the dried solids of the aorta. From this time onwards the amount rises steadily: it was a surprise to me, when I came to draw out the curve from my figures, how nearly it approached a straight line. In the fifties the CaO percentage averages 1.5, and in the sixties 2 per cent., and this however normal the vessel may appear to the naked eye. This great increase in calcium is associated with diminished arterial efficiency. It cannot be due to living ionic calcium, indeed it may be guessed that the amount of "vital" calcium diminishes with the impaired efficiency of the vessel. It must be due to the deposit of insoluble lime salts—"rubbish-heap calcium" as I termed it in a previous page. Of this we have abundant histological evidence, for sections stained by the silver nitrate method reveal abundant black dust in the middle coat and elsewhere. It is true that the silver method does not stain calcium, but phosphates, but as the great bulk of the calcium is in the form of phosphate, this is immaterial. I have never found histological evidence of lime salts in a normal aorta below the age of 40 years; above that age it becomes increasingly easy to demonstrate their presence. It is probable that all the calcium above 0.4 per cent. CaO in the arterial wall is of the nature of an inert mineral deposit. Most of this inert calcium is known to be in the form of phosphate, and I must here remark that though I have given my results, in accordance with the best chemical usage, in terms of CaO, the figures given would be nearly doubled if they were expressed in terms of calcium phosphate.

THE TOTAL ASH OF THE NORMAL AORTA.

So far I have confined my remarks to the calcium present in the arterial wall, but as I have given the figures as to the total ash, it will be well to show a graphic curve and to draw what conclusions seem permissible. The set of cases is identical with that on which the calcium curve is based. I have not attempted any analysis of the ash beyond the CaO determination, but it is plain to the naked

eye that many ashes contain a fair amount of iron, being reddish in colour and giving ordinary iron reactions on testing. In young vessels the ash is often fusible and contains much alkali, tending to attack a silica dish or platinum crucible. It is difficult to obtain complete incineration in these cases, as the carbonaceous particles become sheathed with fused salts. Prolonged use of the blowpipe is to be deprecated, as a good deal of volatile material, presumably alkaline chlorides, is driven off in white fumes. It is for this reason that the ashes in different cases are sometimes not strictly comparable. As the CaO percentage in the ash rises with advancing years, the ash becomes white and feathery, with no tendency to fuse; complete incineration is more easily attained and there is much less loss of volatile material.

In the two charts subjoined, I have graphically shown the curves for all ages: (1) of the *total ash* of the normal aorta, with the calcium curves added for comparison, reckoned in terms of both phosphate and oxide; and (2) of the *CaO percentage of the ash*. As might be expected, this last curve is almost identical with that of the CaO in the total dried solids, and shows a gradual increase after the age of 20 years, tending to be more abrupt at the ages of 20 and 40.

The comparison between the total ash curve and the calcium is instructive.

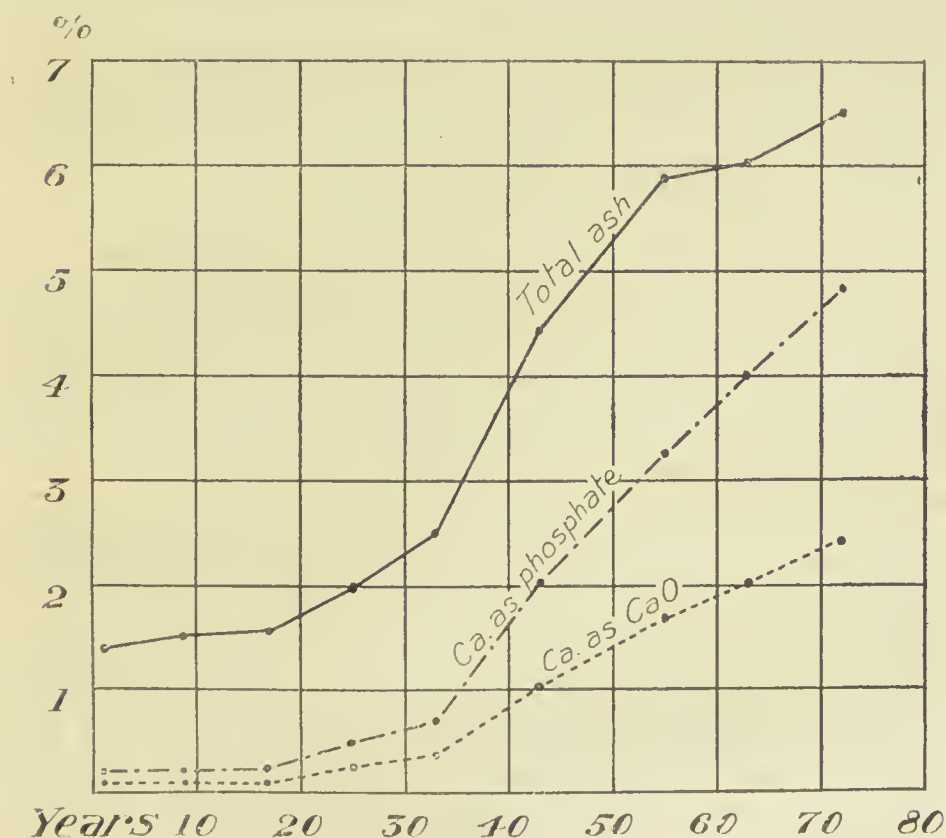
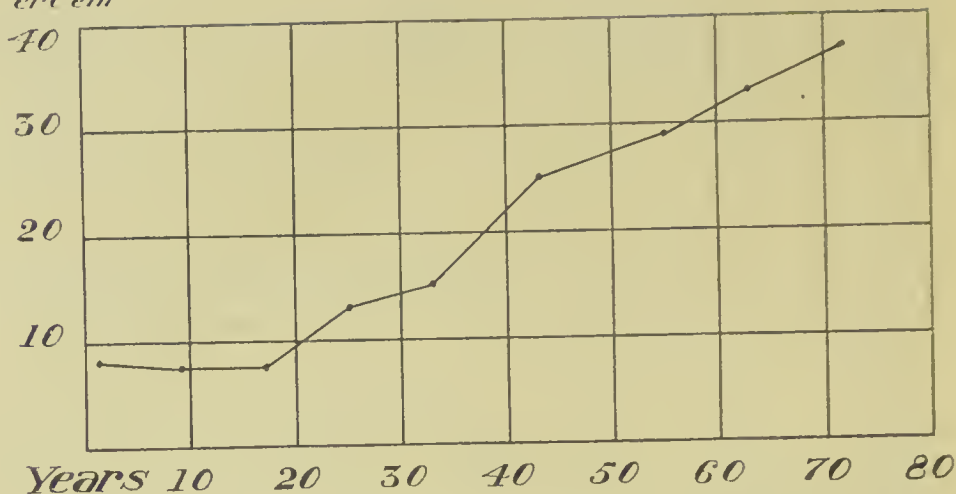


Chart showing the ash curve of the normal aorta at all ages, with the CaO curve at the bottom as a dotted line, and between the two the calcium curve reckoned as phosphate.

Per Cent



Curve of the CaO percentage present in the ash of normal aortas for all ages.

Until we reckon the calcium in terms of phosphate, which in this case we are fairly entitled to do, considering that the great bulk of it is in this form in the senile artery, it might seem as if a large part of the increase in the ash with advancing years were due to something else than calcareous deposition. But it is seen that as phosphate such calcareous deposit is practically responsible for the whole increase in the ash in later life.

From this it follows that for all rough purposes we may take the ash percentage of the dried aorta as almost as good a criterion of senile degenerative change as the much more laborious estimation of the calcium. I suspected this when I commenced the research and the figures show that the surmise was correct.

THE CALCIUM-CONTENT OF THE AORTA IN DISEASE.

In addition to the analysis of the normal aorta, I have similarly examined some 40 vessels which were evidently diseased, and I will now, in conclusion, state the results from these in the light of the figures obtained from normal sources. In most arterial degenerations there is an increased calcium-content, but there is one in which the reverse is the case, namely syphilis, and I will deal first with the syphilitic cases.

The Ash and Calcium Figures in Syphilitic Disease of the Aorta.—The figures which I have obtained are from cases of actual syphilitic disease of the aorta itself: they must not be taken as analyses of the unattacked aorta in those suffering from syphilis. I shall have to point out that a syphilitic aorta may give very different results, as regards calcium, in the regions attacked and those not affected, in which latter ordinary sclerotic changes may lead to a very high percentage of calcium. In several of my cases I have not been able to analyse the regions where the syphilitic disease was most advanced, because the specimens were required for other purposes, but I have taken the most suitable parts available.

I have had the opportunity of completely analysing 10 certainly syphilitic aortas and one in which the diagnosis was open to doubt. Six were cases of sacculated or dissecting aneurysm, one was a case of aortic regurgitation with angina pectoris, two, including the doubtful case, were instances of very early syphilitic aortitis, and

two were cases of advanced syphilitic disease of the aorta, without aneurysm. The clinical and pathological data as regards these 11 cases are as follows. I will deal separately with the cases which seemed purely syphilitic and those in which ordinary sclerotic changes appeared super-imposed upon old syphilitic disease.

Case 1.—Policeman, age 30, formerly in the Indian Army. Died of hæmorrhage from a gastric ulcer. The kidneys were normal and the heart weighed $9\frac{1}{2}$ oz. The aorta, otherwise normal, showed three well marked raised plaques, one in the arch, one in the descending thoracic and one in the abdominal aorta. They were sharply defined and showed no evident fatty changes. Microscopic sections of one of them showed the typical picture of syphilitic mesaortitis, with extensive damage to the middle coat. Wassermann's test was not done.

Case 2.—Female, age 38. There was a history of five miscarriages, the last four weeks before death : three children were living and well. The patient suffered from primary arterio-sclerotic kidneys, with high blood pressure (190 mm. Hg.) and the heart weighed 20 oz. Death was from cardiac failure. The aorta presented numerous circumscribed, succulent, reddish grey plaques, strongly suggestive of syphilis. Histologically I found the damage to the media, though distinct, less than that usually found in syphilis. The blood, kept after death for Wassermann's reaction, underwent putrefaction and though the reaction was negative the result was inconclusive. I must class this case as unproven from the point of view of syphilis.

Case 3.—Male, age 39. Double aortic murmur, with angina pectoris of four months' duration : died suddenly in an anginal attack. The aorta showed typical advanced syphilitic disease, being tough, thick, scarred and nodular, with no trace of calcification. The changes were most advanced in the ascending arch and had involved the valve. The coronary arteries arose from a single orifice, which was so narrowed that it did not admit a small probe. The histological changes in the aorta were characteristic of syphilis and it was certain that the condition was syphilitic, but in blood taken after death Wassermann's reaction was negative.

Case 4.—Female, age 44. Died of a large aneurysm of the arch of the aorta. Wassermann's reaction was strongly positive during life. Only the abdominal aorta was taken for analysis.

Case 5.—Male, age 55. Had been treated for syphilis but Wassermann's reaction was still positive. Death was from hæmorrhagic pancreatitis. The kidneys were slightly granular, with a few cysts, and the heart weighed 13 oz. The aorta showed advanced atheromatous degeneration, with ulcerated fatty plaques but hardly any calcification. The changes were most marked in the arch. Only the abdominal aorta was taken for analysis. The histological changes in the aorta were characteristic of syphilis.

- Case 6.*—Male, age 58. Died of pneumonia, with cerebral symptoms. The trachea showed a hæmorrhagic condition, with ulceration, which was apparently syphilitic, especially in its histological characters. The heart and kidneys were normal. The aorta was thickened and degenerate. Wassermann's reaction was strongly positive after death.
- Case 7.*—Male, age 57. Died of rupture of an abdominal aneurysm which had eroded the vertebræ. The aorta showed the typical changes of old syphilitic disease, with puckered scars and small incipient aneurysms. There was no calcification and Wassermann's reaction was strongly positive after death. Only the thoracic aorta was kept for analysis.
- Case 8.*—Male, age 60. Died of a dissecting aneurysm of the aortic arch and innominate artery, rupturing into the pericardium. The splitting of the coats was traced all down the aorta. The aortic wall showed much degeneration but practically no calcification: the histological changes were typical of syphilis. Wassermann's reaction was strongly positive after death. The whole abdominal aorta and part of the thoracic were kept for analysis.
- Case 9.*—Male, age 64. Died of a dissecting aneurysm, rupturing by a rent $1\frac{1}{2}$ in. long into the pericardium. The splitting of the coats reached down to the iliac arteries. The aorta was supple and tore easily; it presented many yellowish nodules, not ulcerated, and no calcification was anywhere apparent. There was also great hypertrophy of the heart (20 oz.), associated with primary granular kidneys. The blood kept for Wassermann's reaction was unfortunately lost. Microscopic examination of the aorta showed changes typical of syphilis. The abdominal and part of the thoracic aorta were kept for analysis.

Besides these purely syphilitic cases, I have two in which advanced sclerosis with calcification was present in those parts of the aorta where there was little or no evidence of syphilis. In these, which were both cases of thoracic aneurysm, it was a striking thing to note the absence of calcareous changes in the arch in comparison with the abdominal aorta.

Case 10.—Male, age 50. Admitted dying to the hospital, an aneurysm of the descending arch having ruptured into the pleura and bronchi. Wassermann's reaction was positive after death, and a section of the arch showed the ordinary histological changes of syphilitic aortitis. There was no calcification about the arch, and only a few calcareous plaques in the descending aorta above the diaphragm. The abdominal aorta was highly calcareous, especially for 2 inches above the bifurcation. The descending thoracic aorta and the abdominal aorta were dried and analysed separately.

Case 11.—Male, age 52. Died of a large aneurysm of the first part of the arch, involving the origins of the great vessels of the neck. The heart weighed 15 oz.; the kidneys were large, slightly fibrotic and showed two cortical cysts. The patient admitted syphilis when a young man, and had in his liver scars suggestive of that disease. Wassermann's reaction was, however, negative both before and

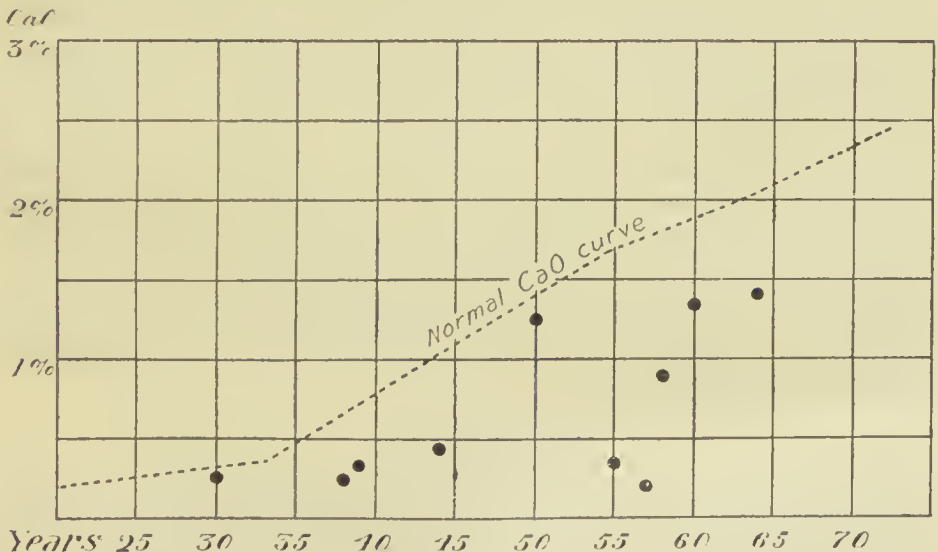
after death. The arch in the vicinity of the aneurysm showed no calcareous changes; but there was extreme calcification lower down, and between the renal arteries and the bifurcation of the aorta the vessel was a rigid tube. The descending thoracic and abdominal parts were taken for analysis.

The results of analysis in these 11 cases were as follows:—

TABLE OF ASH AND CaO CONTENT OF SYPHILITIC AORTAS.

Case.	Age.	Weight of dried aorta, in grammes.	Weight of ash, in grammes.	Weight of CaO obtained, in grammes.	Ash percentage of total solids.	CaO percentage of ash.	CaO percentage of total solids.
1	30	7.131	0.166	0.019	2.327	11.67	0.272
2	38	6.639	0.1416	0.0187	2.13	13.26	0.283
3	39	7.2607	0.184	0.024	2.54	13.009	0.3306
4	44	3.4857	0.093	0.0151	2.67	16.21	0.434
5	55	4.469	0.144	0.0154	3.22	10.07	0.344
6	58	13.80	0.432	0.1175	3.13	28.74	0.898
7	57	12.017	0.265	0.0228	2.209	9.179	0.203
8	60	9.875	0.504	0.1315	5.103	26.09	1.33
9	64	7.476	0.328	0.105	4.38	32.02	1.405
10 (thoracic).	50	16.835	0.8238	0.2141	4.89	25.98	1.27
10 (abdominal).	50	8.419	1.188	0.5628	14.11	47.38	6.68
11	54	15.489	5.4128	2.7974	34.94	51.68	18.06

The significance of these figures is best appreciated in relation to the normal age curve for CaO. The following chart shows the facts at a glance. It represents the CaO percentage of the dried solids in the nine purely syphilitic cases and in the thoracic aorta of case 10.



Spot map of the CaO percentage of ten purely syphilitic aortas in relation to the normal CaO curve at all ages. Each result is entered as a heavy black dot at the proper age.

It is seen that in every case of syphilitic disease of the aorta (upon which later and independent ordinary arterio-sclerosis has not been superimposed) the calcium content is below the normal for that age period, and often very greatly below it. In several of the cases at 50 years and over there was actually some degree of ordinary sclerosis as well as syphilitic disease, notably in the thoracic aorta of case 10 (50 years), so that even the figures given probably do not fully exhibit the poverty in calcium which seems to characterise the syphilitic affection *per se*. This poverty is particularly well seen in cases 5 and 7 (at 55 and 57 years), in whom the normal deposit of calcium with advancing years seems completely arrested, so that their vessels present the CaO content of a man in the twenties. In both these cases Wassermann's reaction was still positive at death.

On the other hand the figures from the abdominal aorta of cases 10 and 11, not included in the graphic chart, show that the past occurrence of syphilis is no bar to the most extreme grade of calcareous deposition later in life. The figure of 18.06 per cent. CaO in the total solids of the aortic wall is by far the highest I have ever met with. The nearest approach to it is 11.47 per cent., which I found in the aorta of a woman of 63, the subject of granular kidney and cardiac hypertrophy, who died of cerebral hæmorrhage. I have found no such high percentage elsewhere recorded: Gazert's highest figure is 8.79 per cent., in a person 70 years of age, while Schlig's highest figure, in a woman of 82 with universal arterio-sclerosis of high degree, works out at 15.55 per cent.

The figures I have obtained in syphilis are in complete harmony with well established post-mortem facts. It has long been observed that calcification is habitually absent in syphilitic disease of the aorta, indeed this has come to be one of the criteria by which the recognition of this condition is helped. My facts place the matter on a more definite numerical basis than before. Looking, in their light, through Gazert's list of analyses, one may readily pick out at least half a dozen cases from his 33, which must almost certainly have been syphilitic.

In our present state of ignorance as regards calcium metabolism, we can merely regard this poverty in calcium, shown by the syphilitic aorta, as an interesting but unexplained fact. I do not know how far it is shared by other tissues in syphilis, or whether it is due to a diminished absorption or an increased excretion. The subject of calcium metabolism in syphilis is probably one which would repay thorough study, but it is one which lies outside the scope of my present investigations. The facts as to the aorta concern us here to this extent, that they constitute a serious disturbing factor in any proposal to use the ash or calcium percentage of the arterial wall as a *general* index of arterial degeneration. Before drawing any conclusion it is necessary to know, on other grounds, whether the vessel in question is syphilitic, a diagnosis which can usually be made easily enough. In a doubtful case, a marked poverty in calcium may assist the diagnosis.

Diabetic Coma.

It might be expected that in the acid intoxication of diabetic coma, in which it is known that there is an increase in the elimination of calcium from the body, the tissues, including the aorta, would show a diminished calcium percentage. I have had only one opportunity of testing this surmise, and the result was not very striking.

The patient was a man of 24 years who had suffered from diabetes for seven months. He died in coma two days after admission to hospital, and had plenty of β -oxybutyric acid in the urine: the duration of the acid intoxication was not known. The aorta, which looked normal, contained 2.05 per cent. ash, and 0.208 per cent. CaO. The normal CaO figure for his age would be 0.25, so that there seems to have been a slight reduction.

THE ASH AND CALCIUM FIGURES IN ARTERIO-SCLEROSIS.

Excluding syphilitic cases I have analysed rather more than 20 aortas exhibiting arterio-sclerotic changes. The cases embrace most of the varied types of this affection, and every degree from the earliest to the most extreme. I hoped, when I began the research, to find in the calcium figures a clue for guidance amongst the protean forms of arterial degeneration and a means of testing certain of the alleged causes leading thereto. These hopes have been but imperfectly realized. I pointed out in my former report how the different primary types of arterial degeneration, medial and intimal, nodular and diffuse, were seldom seen in their pure form, but in actual practice are found variously combined in individual cases. This is perhaps the reason why the calcium figures I have obtained are so variable that for the most part I hesitate to draw definite conclusions. The number of cases is also small.

Certain conclusions, however, do emerge from the facts, even if negative ones. I propose to set forth my data in the following manner. Amongst the causes commonly put forward in explanation of premature arterial degeneration are high blood pressure from chronic renal disease and the abuse of alcohol. I have analysed the aorta in nine cases of renal disease with high blood pressure, and as concerns the ash only, in two more. I have analysed the aorta in six pronounced alcoholic cases, and there remain seven cases in which there was no evidence of renal disease and high blood pressure, and no reason for suspecting alcoholism or syphilis. I shall, therefore, divide my cases into three groups. (1) the high pressure group. (2) the alcoholics. (3) the miscellaneous group in which the two causes just named appear to be excluded. Having given the data for each group, I shall plot out the CaO percentages on "spot maps" in relation to the normal calcium curve for all ages. The three groups can then be compared at a glance, so far as concerns the calcium-content of the aorta.

GROUP I.—*Cases of chronic renal disease with high blood pressure.*

The evidence of high blood pressure has sometimes been direct, *i.e.*, from actual measurements during life. In other cases it has been indirect, from the presence of left ventricular hypertrophy for which no other cause could be found.

Case 1.—Female, age 35. The subject of primary granular kidney, of at least $2\frac{1}{2}$ years' duration. Observed blood pressures—196 and 198 mm. Hg. The kidneys weighed $3\frac{1}{2}$ and 5 oz. The heart weighed 17 oz. The aorta was thick, not visibly calcareous, and showed numerous plaques of early nodular sclerosis, not yet degenerate or ulcerated. Death was from peritonitis.

Case 2.—Male, age 39. Mixed nephritis of some years duration (secondary contracting kidneys). Death was from uræmia. Observed blood pressures 260, 200 and, before death,

140 mm. Hg. The heart weighed $16\frac{1}{2}$ oz. The aorta showed little change, but there were small early plaques of nodular sclerosis about the origins of the carotids and subclavians and along the abdominal aorta.

Case 3.—Female, age 53. Primary granular kidney with marked thickening of the small arterioles. Death from cardiac failure and empyema. Observed blood pressures 260, later 205 and 180 mm. Hg. The heart weighed 21 oz. The aorta was thick, with widely distributed nodular sclerosis, but no visible calcification. The plaques were somewhat fatty, but nowhere ulcerated.

Case 4.—Female, age 55. Death was from cerebral hæmorrhage. The kidneys looked normal, but microscopically showed much thickening of the arterioles. The heart weighed $16\frac{1}{4}$ oz. The aorta was supple and showed little thickening and no sign of calcification. There was a little early nodular sclerosis about the origins of its branches.

Case 5.—Male, age 55. Death from cerebral hæmorrhage. Primary granular kidneys: the heart weighed 18 oz. The aorta was thick and hypertrophied, but supple and in good condition, with some fatty streaks and a little early nodular sclerosis, but no sign of calcification to the naked eye.

Case 6.—Male, age 55. Primary arterio-sclerotic kidneys. The heart weighed $28\frac{1}{2}$ oz. The aorta was extremely degenerate, the more so the further from the heart. It showed large semi-confluent plaques of sclerosis with much calcification and atheromatous ulceration. The iliac arteries were thick and dilated.

Case 7.—Female, age 63. Death was from cerebral hæmorrhage. There was extreme fibrosis of the kidneys, which weighed $2\frac{1}{2}$ and $2\frac{3}{4}$ oz. The heart weighed 18 oz. The aorta, especially its abdominal portion, showed widespread atheroma with much calcification.

Case 8.—Male, age 64. Death was from cerebral hæmorrhage. The blood pressure after the hæmorrhage had occurred was 180 mm. Hg. The heart weighed 14 oz. The aorta was moderately thick and showed one small calcareous plate and a number of areas of deep-seated atheroma, not reaching the surface. There was some nodular sclerosis in scattered patches.

Case 9.—Male, age 72. The subject of arterio-sclerotic kidneys and a heart weighing 16 oz. Death was from cortical cerebral hæmorrhage, apparently secondary to areas of softening. The aorta showed some diffuse and nodular sclerosis, but hardly any visible calcification.

In the two following cases in young girls the amount of CaO was too small for estimation, and only the figures as regards the ash are available.

Case 10.—Female, age 16. Death was from cerebral tumour, into which hæmorrhage occurred. Four years previously she had suffered from scarlet fever. The kidneys showed obliterative changes in the arterioles, with interstitial infiltration, and the heart weighed 13 oz. The aorta was thick and more rigid than natural, with an irregularly thickened intima and circumscribed pearly nodules: no calcification was visible even microscopically.

The histology of this case is described in Part I. of this report (IV. Case 14).

Case 11.—Female, age 14. Chronic mixed nephritis (contracting white kidney). Left ventricular hypertrophy. Blood pressure during life, 200 mm. Hg. or more. Death from uræmia. The aorta was thick for a girl of her age, but not degenerate to the naked eye.

The results of the chemical analysis of these 11 aortas are seen in the following table :—

TABLE OF ASH AND CaO CONTENT OF THE AORTA IN RENAL DISEASE ASSOCIATED WITH HIGH BLOOD PRESSURE.

Case.	Age.	Weight of dried aorta, in grammes.	Weight of ash, in grammes.	Weight of CaO obtained, in grammes.	Ash percentage of total solids.	CaO percentage of ash.	CaO percentage of total solids.
1	35	10·309	0·265	0·0408	2·58	15·47	0·395
2	39	9·351	0·250	0·0472	2·67	18·906	0·505
3	53	8·067	0·359	0·1151	1·46	32·007	1·42
4	55	3·322	0·168	0·0429	5·056	25·53	1·29
5	55	10·415	0·552	0·1652	5·305	29·905	1·58
6	55	7·473	1·092	0·5573	14·61	51·007	7·45
7	63	12·421	2·762	1·426	22·23	51·62	11·47
8	64	5·025	0·206	0·0665	4·108	32·203	1·32
9	72	9·858	1·024	0·4044	10·39	39·47	4·102
10	16	3·109	0·031	—	0·99	—	—
11	14	3·890	0·092	—	2·365	—	—

I will defer considering these figures till I come to the spot-map. Here I will only call attention to the ash of the last two cases. The normal ash percentage at this age is 1·58. One of the cases is thus much below and the other much above the normal.

GROUP II.—THE AORTA IN KNOWN ALCOHOLICS.

Case 1.—Male, age 45. A fat man who had swilled beer—10 to 30 half-pints a day, and latterly spirits also. He died of typical alcoholic cirrhosis of the liver, with ascites. He said he had suffered from syphilis at 21, but the body presented no sign of this disease. The aorta was extremely degenerate from end to end with semi-confluent plaques of nodular sclerosis, some still soft, others partly calcified. The kidneys were very large and congested, but otherwise normal.

Case 2.—Female, age 50. An admitted drunkard. Death was from hæmatemesis in cirrhosis of the liver. There was jaundice and also ascites. The heart weighed 11½ oz., the kidneys were normal except for a few small cysts. The aorta exhibited nodular sclerosis with several good sized patches of calcification especially in the abdominal part.

Case 3.—Male, age 57. A publican with an alcoholic history, chiefly beer. Died of advanced cirrhosis of the liver. The kidneys were not apparently cirrhotic, but the heart showed functional mitral reflux and weighed 19¾ oz. The aorta showed some early nodular sclerosis in the

thoracic portion, and an atheromatous ulcer with some calcification just above the bifurcation.

Case 4.—Male, age 58. Had been all his life in the employ of a firm of city caterers, with free access to wine, of which he drank largely—good wine too, chiefly champagne. Died of primary carcinoma of a cirrhotic liver with portal thrombosis and hæmorrhagic ascites. The kidneys showed little change. The heart weighed $15\frac{1}{2}$ oz. (adherent pericardium). The aorta showed nodular sclerosis, mostly fatty, but there were some calcareous plates in the arch and just above the bifurcation.

Case 5.—Male, age 65. A known drunkard. Death was from cerebral hæmorrhage. The liver was fatty and slightly cirrhotic, but not hobnailed. The heart weighed 13 oz., and the kidneys were slightly granular. The aorta was thick; here and there were some slightly calcified areas, but no massive deposit, and no definite nodular sclerosis. The condition of the vessel was on the whole fairly good.

Case 6.—Male, age 75. 13 years before death he was admitted to an asylum with primary alcoholic dementia, and a history of at least five years' steady soaking. He remained demented but had no alcohol for the 13 years before death. The liver was not cirrhotic. The kidneys were large, with some cysts: the heart weighed about 12 oz. Only the arch of the aorta was available for analysis: it was not very degenerate but there was a ring of partial calcification just above the valve.

The figures from these 6 aortas in alcoholics were as follows:—

TABLE OF ASH AND CaO CONTENT OF SIX AORTAS FROM CHRONIC ALCOHOLICS.

Case.	Age	Weight of dried aorta, in grammes.	Weight of ash, in grammes.	Weight of CaO obtained, in grammes.	Ash percentage of dried solids.	CaO percentage of ash.	CaO percentage of dried solids.
1	45	19·081	1·2219	0·4564	6·403	37·35	2·392
2	50	10·1607	1·191	0·5341	11·72	44·85	5·25
3	57	12·4045	0·675	0·1831	5·44	27·12	1·47
4	53	12·392	1·572	0·655	12·69	41·65	5·28
5	65	14·089	0·6647	0·1801	4·71	27·107	1·28
6	75	4·315	0·4726	0·2007	10·88	42·48	4·62

GROUP III.—MISCELLANEOUS CASES OF ARTERIO-SCLEROSIS in which there was no evidence of abnormally high blood pressure, or of alcoholism.

Case 1.—Male, age 35. A dock labourer and a very big muscular man. Death resulted from accident. The kidneys were normal and the heart weighed $12\frac{1}{2}$ oz. The aorta showed early nodular sclerosis at the base and about the origins of the great vessels. There was a small ulcer at the site of the scar of the ductus arteriosus. No calcification could be seen anywhere.

Case 2.—Male, age 42. Until a year or two before death he had been a marine, and had worked in Dover harbour

sometimes up to his middle in water. He had aortic regurgitation and the heart weighed $21\frac{1}{2}$ oz. Death was from malignant endocarditis (streptococcal) supervening on the old valvular disease. The kidneys were normal except for recent infarcts. The aorta was extremely degenerate, with numerous massive calcareous plaques; the abdominal portion and the iliacs were specially affected.

Case 3.—Male, age 51. Death was from cancer of the colon. For three or four years before death he had suffered from intermittent claudication in its classical form and practically no pulse could be felt in the lower extremities. Only the abdominal aorta and iliacs were obtained for examination. The vessels were small, rigid and much narrowed by nodular sclerosis. The last $2\frac{1}{2}$ inches of the aorta showed advanced atheroma and ulceration. No calcification was anywhere apparent. The history of this case was well known and syphilis and alcohol could be excluded.

Case 4.—Male, age 55. Died after an amputation of the leg for gangrene. The vessels of the remaining leg were much calcified. The aorta showed no calcification, but there was well marked nodular sclerosis in the arch and here and there elsewhere in the vessel, with a few atheromatous ulcers.

Case 5.—Male, age 71. Death from cerebral thrombosis. The kidneys showed senile sclerosis, but the heart weighed only 12 oz. The aorta showed slight nodular sclerosis and a few atheromatous patches with a little calcareous deposit. The iliacs were rather dilated.

Case 6.—Female, age 78. Death from intestinal hæmorrhage in duodenal ulcer. The kidneys showed marked senile sclerosis, but the heart weighed only $11\frac{1}{2}$ oz. The aorta showed a moderate degree of degeneration, with small fatty patches, some ulcerated. There was no visible calcification.

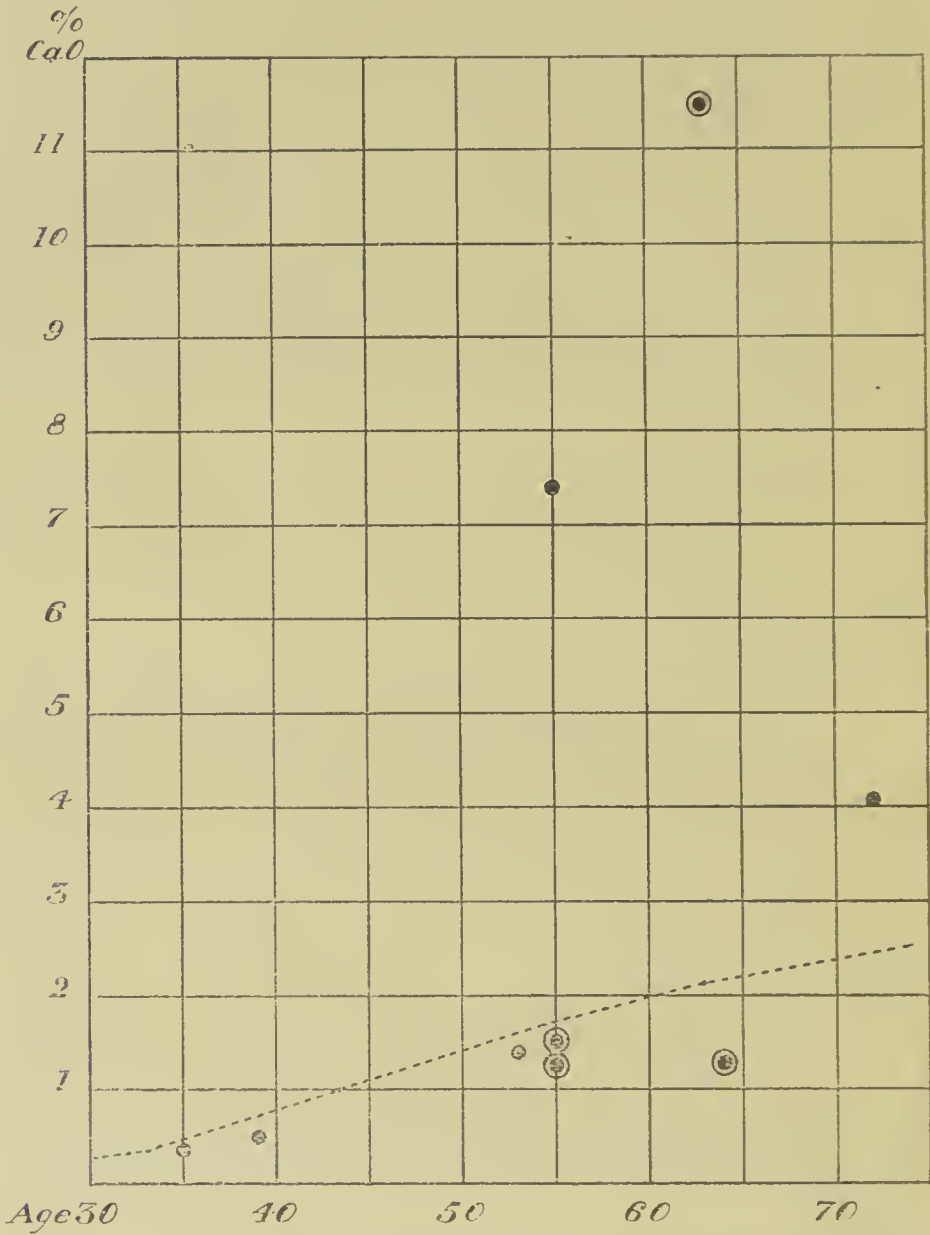
Case 7.—Male, age 81. The subject of extreme senile atheroma. The aorta was rigid, brittle and calcareous throughout, with no normal areas. Death resulted from the giving way of an atheromatous ulcer, whereby the aorta ruptured by a small aperture into the pericardium. The part analysed consisted of the abdominal aorta and iliacs.

The figures from these seven various cases are seen in the following table:—

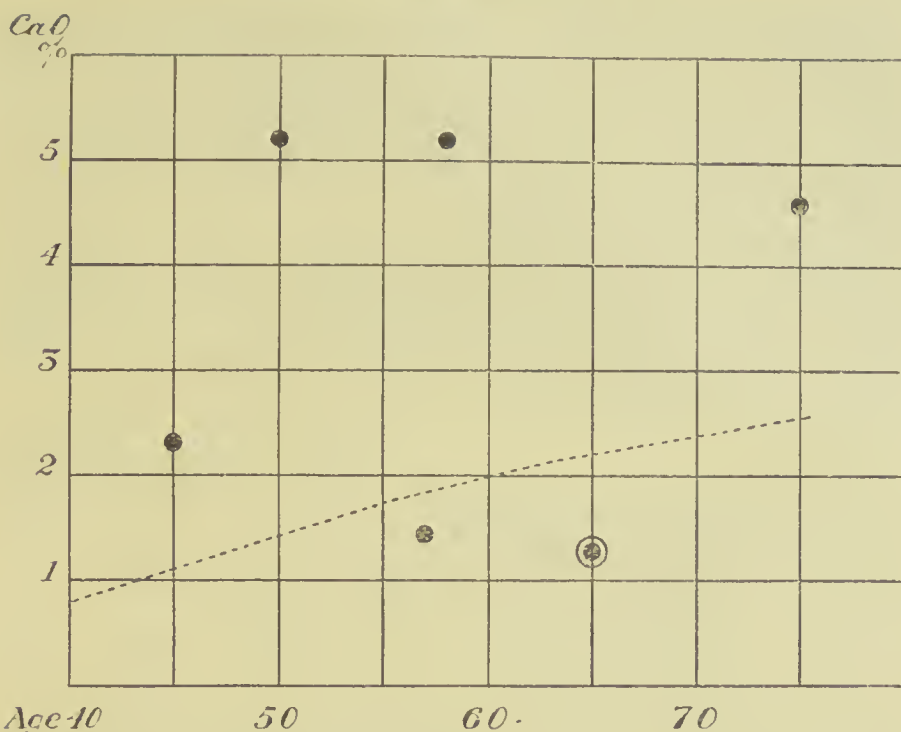
TABLE OF ASH AND CaO CONTENT OF SEVEN MISCELLANEOUS ARTERIO-SCLEROTIC AORTAS.

Case.	Age.	Weight of dried aorta, in grammes.	Weight of ash, in grammes.	Weight of CaO obtained, in grammes.	Ash percentage of dried solids.	CaO percentage of ash.	CaO percentage of dried solids.
1	35	9.081	0.272	0.0735	2.99	27.04	0.81
2	42	8.397	0.811	0.177	9.6	58.81	5.68
3	51	0.7645	0.022	0.0088	2.88	40.16	1.15
4	55	13.790	1.0909	0.1105	7.91	37.63	2.97
5	71	11.755	0.595	0.201	5.06	33.78	1.71
6	78	3.819	0.077	0.0271	2.01	35.228	0.71
7	81	18.199	3.801	0.6265	20.882	16.485	3.43

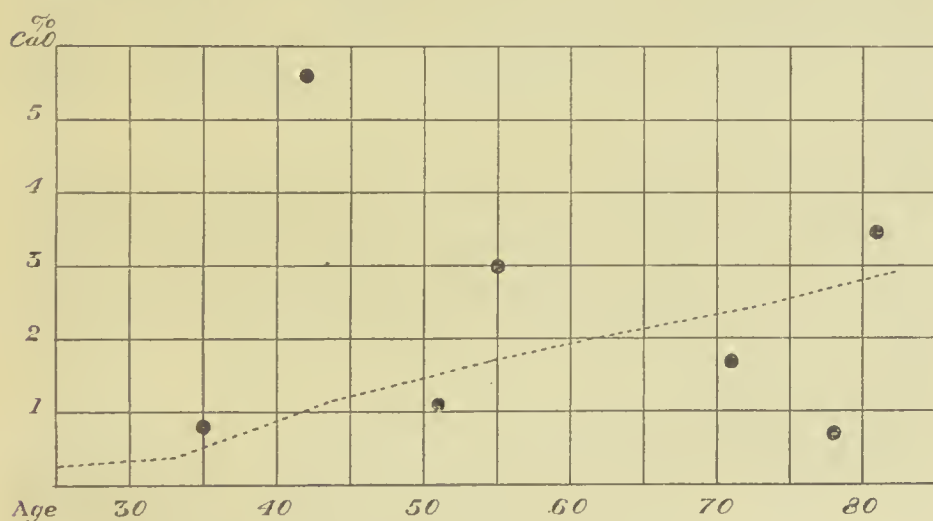
If now the CaO results in these three groups of cases are put out in the form of spot maps we get a bird's-eye view of the facts which is clearer than lists of figures.



Spot-map of the CaO content of nine aortas from persons who were the subjects of high blood pressure. Each result is shown by a heavy dot at the appropriate age, in relation to the normal calcium age curve, indicated by a dotted line. The ringed spots are cases of cerebral hæmorrhage.



Spot-map of the CaO content of six aortas from alcoholics in relation to the normal calcium age curve. The ringed dot is a cerebral hæmorrhage.



Spot-map of the CaO content of seven sclerotic aortas from persons who were neither alcoholics nor had abnormally high blood pressures.

I have now to consider whether any conclusions at all can be drawn from the figures I have given, for it must be confessed that the first impression derived from the spot-maps is one of bewilderment. There is no great difference between the three maps: all shew calcium figures much above and below the normal curve.

The relation between the degree of arterial degeneration and the CaO percentage.

To settle this point the facts must be grouped otherwise than I have done in the spot-maps. I have shortly described the morbid anatomy of the aorta in 22 cases, all of which I believe to be

non-syphilitic, and these can be grouped according to the degree of degeneration visible to the naked eye.

They include (1) five cases of early nodular sclerosis with no ulceration; (2) five cases of widespread nodular sclerosis without visible calcification; (3) seven cases of advanced sclerosis with patchy calcification; (4) five cases of more extreme confluent sclerosis with much calcification.

I have worked out the CaO figures for every case in relation with the percentage normal for the age, and while in each group there are considerable individual variations the excess of CaO above the normal becomes progressively greater in each group. I have already given the details on which the calculations are based, and I will here simply state the results:—

Group,	<i>Average extent by which the CaO percentage exceeds the normal for the patient's age.</i>	
(1) Early nodular sclerosis	0.027	
(2) Widespread sclerosis without visible calcification	0.066	
(3) Advanced sclerosis with patchy calcification	1.06	
(4) Confluent sclerosis with much calcification	4.4	

It is plain that the increase of lime salts in the early stages of sclerosis is comparatively slight, but leaps up with a bound as soon as visible calcareous changes become apparent. The grouping of the cases is based on my notes taken in the post-mortem room before chemical analysis, and the correspondence between my general impression of the condition of the aorta and the ultimate chemical analysis is fairly close, though with certain exceptions which I cannot explain.

It does not need chemical analysis to prove that an obviously calcified vessel contains lime salts in excess, but it is useful to have a measure of such excess. The averages above tabulated do not indicate the extreme to which the excess may rise. In discussing arterio-sclerotic changes superimposed on syphilitic disease of the aorta, I have already mentioned the case of a man of 54 years whose lime salts were 16.46 in excess of the percentage to which he was by age entitled.

The impression left on my mind by the study I have described is that, in non-syphilitic cases, the calcium figure for a given aorta has a real value as an approximate numerical expression of the degree of degenerateness. It can be approximate only, for reasons which I have already urged, and in all cases it must be taken in relation with the age of the subject. But I hold it to be of sufficient use to justify the construction of such spot-maps as I have attempted above, and to which I must now return. If the considerations just urged be accepted, it follows that the individual spots represent not merely the CaO percentage but the rough degree of degeneration in the aorta.

Cases with high blood pressure.

The figures shown in the first spot-map are not what I anticipated. In view of the experimental results obtained in rabbits by the injection of adrenalin, by daily inversion and other methods, in which sclerotic changes were produced in the arteries in a comparatively short time (less than a year), I expected to find evidence of advanced degenerative change in the aorta in the subjects of chronic renal disease and especially in those with arterio-sclerotic

kidneys. It is practically certain that high blood pressure must have existed in all my nine cases for a considerable time, and in half of them this was known from actual measurements during life. Yet only three of the cases show any excess of calcium in the aorta over that normal to their age period, though in two of these the increase is very great. The other six fall a little, but not much, below the line I have adopted as normal. I lay no stress on the fact that they are a little below it because my curve, being founded on a small number of cases, may not be quite correct. But the point is that they show a calcium figure which fails to rise above an average based on at least an equal number of cases not the subject of chronic renal disease or high blood pressure. Reference to the short clinical notes will show that the aortas in these cases did not present to the naked eye any changes suggestive of advanced degeneration.

It is especially noteworthy that out of five cases in which death occurred from true intracerebral hæmorrhage (four in the first map, and one in the second) only one presented advanced degeneration of the aorta. In the remaining four cases, so far as morbid anatomy and chemical analysis show, this vessel was not in worse condition than mere age would explain. It is true that cerebral hæmorrhage depends on the condition of the minute vessels of the brain rather than on that of the aorta, but I am here discussing the effects of a raised blood pressure, certainly present in these cases and probably for years, upon the aorta itself.

My cases are not numerous, and I by no means wish to put them forward in opposition to the well-established clinical view that high blood pressure is concerned in producing premature arterial degeneration. But they certainly show that high blood pressure may exist for a considerable period without any sign of unusual degenerative change in the aorta. The only way in which I can reconcile my figures with the commonly received view is to suppose that the high blood pressure of renal disease leads in the first place to a true arterial hypertrophy, which only after a prolonged period gives place to degeneration. It must be borne in mind that renal sclerosis in man is extremely slow and insidious in its onset, whereas the experimental methods which have been employed in rabbits are abrupt, temporary and relatively violent. The spot-map shews that in these high pressure cases, it is at the younger age periods (below 55 years) that degenerative changes are slight or absent in the aorta : the high calcium figures are at 55 years and over. A compensatory hypertrophy would more easily be maintained the younger the patient.

The effect of Alcohol.

The six cases shown in the second spot-map represent all the pronounced alcoholics met with in this research ; I selected them for analysis because they were alcoholics and not because they presented any high degree of arterial degeneration. In four out of the six, and in three out of four with advanced cirrhosis of the liver, the degree of arterial degeneration is seen to be a high one, and the figures, few as they are, tend to support the view that excessive indulgence in alcohol conduces to arterial degeneration. On the other hand it is plain that some alcoholics escape this degeneration, for in two out of my six cases, including one of cirrhosis of the liver, there was no degeneration of the aorta beyond that natural to the age at death. The whole question of the relation of alcohol to arterial degeneration is a complex one. I dealt shortly with the matter in my previous

report and pointed out the scarcity of direct evidence. Such data as I here give, though too few for any definite conclusions, seem to me to be on lines which might help to settle the question, if they were pursued on a more extensive scale.

With regard to the third spot-map I have little comment to offer except that it is clear, from cases three and six in that series, that there does exist a form of arterio-sclerosis, other than the syphilitic, in which the aorta may present advanced disease and even ulceration, with no increase, or even a marked poverty, in lime salts. It may be conjectured that such failure of calcareous deposition in the affected areas is due to some peculiarity in the calcium metabolism of the individual; I see no ground for supposing that it represents any special form of arterio-sclerosis.

SUMMARY AND CONCLUSIONS

AS REGARDS THE CALCIUM CONTENT OF THE AORTA IN DISEASE.

The analysis of some 40 diseased aortas and a comparison of the CaO percentage with the normal age curve permits of the following conclusions:—

1. In *uncomplicated syphilitic disease* of the aorta, even when very advanced, the percentage of calcium is notably below the normal.
2. *Old syphilitic disease* of the aorta, *e.g.*, in aneurysm, may be complicated by ordinary arterio-sclerosis in other parts of the vessel, which may here show an extreme degree of calcification, absent in the region attacked by syphilis.
3. In *ordinary (non-syphilitic) arterio-sclerosis* the calcium content of the aorta is scarcely raised in the initial stages. In a few cases extensive fatty changes and ulceration may occur without calcareous deposition, perhaps owing to a peculiarity of calcium metabolism in the individual. In the majority of cases calcareous deposition commonly sets in along with fatty changes in the advanced disease and the calcium percentage speedily becomes greatly increased.
4. Apart from syphilis and from the aberrant cases noted in the preceding paragraph, the calcium percentage of the dried arterial wall offers a rough numerical expression of the degree of degeneration, sufficiently close for the construction of curves and spot-maps.
5. *High blood pressure* does not necessarily lead to degenerative changes in the aorta, at least for a considerable period. In four out of five cases of cerebral hæmorrhage the aorta was in its ordinary condition in relation to the age of the patient, and much the same is true of renal disease. It is suggested that the condition of the aortic wall in high blood pressure is at first one of hypertrophy.
6. There is some evidence from chemical analysis that excessive indulgence in *alcohol* conduces to premature arterial degeneration.
7. The figures from diseased aortas must in all cases be interpreted in relation to the normal age curve of calcium. The senile changes described in the earlier part of this report go on concurrently with the changes produced by disease.
8. It is probable that the mere ash percentage of the dried aorta offers almost as good an index of the condition of the vessel as the more elaborate calcium estimation.

APPENDIX B., No. 2.

REPORT on an INVESTIGATION into the POSSIBILITIES of SEROLOGICAL DIAGNOSIS of SCARLET FEVER ; by L. RAJCHMAN, M.D.

Early investigations concerning the serodiagnosis of scarlet fever have been undertaken mainly with the object of testing the clinical specificity of the Wassermann test for syphilis, as it has been observed that sera of scarlet fever patients sometimes give a positive Wassermann reaction during the acute stage of the disease. It was proved subsequently, however, that this did not occur regularly, and no positive reactions were obtainable after the recovery of the patient. Szymanowski and I tested in 1909 the sera of several medical men and students who had had scarlet fever but no syphilis, and we never obtained a positive Wassermann reaction with any of these sera ; the medical men were chosen as persons who were aware of their "anamnesis."

An attempt at a *specific* serodiagnosis of scarlet fever was first made by *Lateiner, Hecht, and Wilenko* (1) in 1909. These authors obtained negative results when using an alcoholic extract of a liver from a fatal case of scarlet fever as antigen for the complement fixation test. *Hündel and Schultz*, (2) as well as *Uffenheimer*, (3) were more fortunate with a watery extract of a liver similarly obtained.

Extracts of various other organs from scarlet fever cases have since been tested as to their antigenic properties by *J. Barannikoff*, (4) in Russia, and *Koessler and Koessler*, (5) in America, with the result that extracts of lymphatic glands were shown to give the highest percentage of positive results, the extracts of kidneys to come second, and those of liver to be much less active, whilst extracts of scales proved entirely inactive. The complement fixing bodies were found absent from the patient's blood till the commencement of the second week, and persisted in some cases till the twelfth week.

Isabolinsky and Legeiko (6) have quite recently taken up the same subject, using a similar technique, with the result (a) that the percentage of positive tests never exceeded 50 per cent., (b) that the majority of positive tests was obtained in mild cases, (c) that positive tests may be obtained in some cases of erysipelas, angina, and polyarthritis, (d) that there was no constancy in the result, the reaction appearing sporadically in the patients.

No mention need be made here of the very numerous attempts at a serum diagnosis of scarlet fever by the use of streptococci as the antigen, since there is no evidence to show any specific rôle of streptococci in the etiology of scarlet fever and one cannot, therefore, attribute strict specificity to such methods.

All the above specific experiments were undertaken with the view of detecting specific antibodies in the patient's blood when tested against extracts of organs containing presumably the unknown virus of scarlatina. Inasmuch as the presence of such antibodies is indicative of an infection already accomplished, and these antibodies do not appear in the blood until the commencement of the second week*, the problem of an early detection of the scarlatina virus cannot be regarded as having been solved by the above investigations.

* See Koessler and Koessler (above).

The complement fixation test, however, may be usefully applied for the detection of any *antigen*, providing a sufficiently powerful and specific diagnostic serum be employed. If a serum of this character could be obtained in the case of scarlet fever, one could assume the possibility of detecting the unknown virus in the various discharges of the patients and in any material presumably infected. A similar method has been successfully applied for the detection of typhoid bacilli (7), (7a), (7b) in infected water and of cholera vibrios in faeces (8), (8a). The preparation of a diagnostic serum in these two instances does not present any difficulties since both the typhoid and cholera organisms are excellent antigens.

In the case of scarlet fever the initial difficulty arising is that of the "immunising substance." The material for the immunisation of animals obviously must be sufficiently pure in order to ensure the full effect of immunisation, and not to produce any secondary antibodies which might be induced by the presence of extraneous bacteria of a secondary infection in the specific material. The nature of the virus is unknown; it may be that it is a filter passer since *G. Bernhardt* (9) claims to have infected monkeys in 1911 with bacteria free Berkefeld filtrates. *Landsteiner and Levaditi* (10), *Levaditi and Prasek* (11), (12) and *Cantacuzene* (13), came as well as *Draper and Hanford* (14), however, to conclusions differing from that of Bernhardt, and although a few observers have recently obtained results somewhat resembling those of *Bernhardt*, the controversy is far from being settled. The evidence brought forward is not sufficiently clear to allow either of a detailed discussion or of the forming of a definite judgment on the subject.

The various attempts at a microscopical detection of the virus in the blood have led to a very interesting discussion on the blood picture in the course of scarlet fever, but have scarcely brought forward any tenable hypothesis as to the nature of the unknown organism. All attempts at the cultivation of it have so far failed.

The selection of a suitable "immunising substance" is therefore necessarily limited to the organs, blood and discharges of patients.

The organs, and particularly the lymphatic glands obtained at post mortem, are, as a rule, infected with streptococci or organisms of secondary infection. Cases of pure scarlet fever terminating fatally are exceedingly rare, and material from such cases is not easily obtained.

The blood of patients may be regarded with certainty as free from secondary infection at a given period, when it does not yield any growth on nutrient media. By injecting animals with human blood one might, however, produce an "antihuman" serum capable of reacting with traces of any human albumen and the results of such biological tests might be open to grave criticism in this respect.

The only remaining possibility, therefore, was to employ an infective material, containing little or no albumen, and as such I selected the *nasal discharge* and the mucus from the throat.

Any possible objection that one would likewise produce "antihuman" sera by injecting animals with nasal discharge can be set aside in view *firstly* (15) of the long period and large doses of antigen required to immunise rabbits against human albumen, and *secondly* of the fact that by immunising rabbits with a sample of human nasal discharge extremely rich in albumen I could never obtain a serum reacting with human albumen. The following are the details of the experiment:—

Preliminary Experiment.

Material.—Thick, viscous nasal discharge. Albumen found present.

Bacteriologically.—In the direct smear abundant leucocytes; a comparatively small number of streptococci; partial phagocytosis. In cultures: streptococci; of the streptococcus longus type.

Black Rabbit.—Injected intravenously on three consecutive occasions at intervals of one week with 5 cc. of an “antiformin” extract (5% dil. 27 hours at 37° C.).

Grey Rabbit.—Injected on three consecutive days intravenously with 1, 2 and 3 cc. of extract respectively.

The sample of sera tested against human albumen reacted as follows :—

I.

No.	Black rabbit.	Precipitin test.	Complement fixation test.
1	After first injection ...	1/500, 1/1,000 1/10,000 negative.	1 per cent., 2 per cent., 3 per cent. human serum negative; some- times slightly positive.
2	After second injection .	As above.	As above.
3	After third injection ...	As above.	As above.
4	One week after third injection.	As above.	As above.

II.

No.	Grey rabbit.	Precipitin test.	Complement fixation test.
1	After first injection ...	1/500, 1/1,000 1/10,000 nega- tive.	1 per cent., 2 per cent., 5 per cent. human serum negative; some- times slightly positive (5 per cent.).
2	After second injection (made the next day).	As above.	As above.
3	After third injection (made the next day).	As above.	As above.
4	One week after third injection.	As above.	As above.
5	Animal bled, serum kept, tested 14 days after- wards.	As above.	As above.

Aqueous and “antiformin” extracts of the streptococci isolated were made and tested against the various samples of the two rabbits’ sera by means of the complement fixation test with the result that samples I., 3, 4, and II., 4, 5 gave positive tests.

The various samples of sera were then tested against the whole “antiformin” extract and samples I., 2, 3, 4, and II., 3, 4, 5, reacted positively.

The following conclusions may be deduced from the preliminary experiment :—

- (1) That the immunisation of rabbits with extracts of nasal discharge even when comparatively rich in albumen does not necessarily induce the formation of "antihuman" precipitating or complement fixing antibodies.
- (2) That such an immunisation may induce the formation of antibodies directed against the organisms of secondary infection present in the "immunising substance."
- (3) That the immune serum obtained seems to react more readily with the whole extract of the discharge than with the pure cultures of the streptococci isolated.

It is, therefore, clear that nasal discharge may be used as "immunising substance" provided there is no massive secondary infection.

It is, therefore, necessary to consider the bacterial content of the nasal discharges. An examination of over 150 samples has shewn that, for the purposes of this investigation, all the samples may be divided into three groups :—

- (1) "Very pure" samples yielding not more than five to ten colonies in cultures on selective and control media in spite of a copious inoculation, no organisms being detectable by microscopical examination.
- (2) "Pure" samples yielding more than ten and less than 100 colonies, few organisms being detectable by microscopical examination.
- (3) "Contaminated" samples yielding an abundant growth in culture media and shewing numerous bacteria under the microscope.

Technique of Immunising the Animals.

"Very pure" and "pure" samples alone were used as the "immunising substance" for the immunisation of rabbits.

The point as to whether a particular sample of nasal discharge did or did not contain the specific virus had to be decided simply on clinical evidence ; at this stage of the investigation only samples from acute cases of scarlet fever were used.

As the experimental transmission of scarlet fever to animals was not desired, the "material" had to be treated in such a way as to make it into an effective antigen.

The extracting agent had to be powerful enough to break up the mucus and the cellular elements while not destroying its antigenic properties. *Antiformin** was selected, as it was known particularly from the work of *Altmann*, *Uhlenhuth* (16), (16a) and (16b) and his collaborators, that this re-agent may be used with advantage for the complement fixation test in this connection.

Every sample of nasal discharge was accordingly suspended in 5 cc. of 5 per cent. antiformin, the tube sealed and shaken up in a shaking apparatus and then incubated for 24 to 72 hours at 37°C. The extract was tested for its sterility and if cloudy filtered through paper. The method of immunising the rabbits was as follows :—

·5, 1 and 2 cc. of the extract were injected intravenously on three consecutive days and six days after the last injection a sample of blood was taken and tested as to its efficiency. Should it be found not to be sufficiently efficient, a second series of injections was made.

* Antiformin is a mixture of sodium hypochlorite and sodium hydrate.

As a rule two series of injections proved to be sufficient. Comparative experiments with rabbits injected at intervals of several days shewed that the first method led to an immunisation of the animals more rapidly.

Two groups of samples were selected : (a) "very pure" and (b) "contaminated." The serum of the animal injected with an extract of the "contaminated" samples proved to be of a very small efficiency, as was expected a priori.

The reacting substances in the serum do not persist for a long time in the animal's blood. A fortnight after the second series of injections they are greatly diminished and three weeks after the last injection the serum becomes practically inefficient. The optimum time for bleeding the animal is six to eight days after the last injection of the second series.

Every sample of serum examined was tested by means of the precipitin reaction against human albumen, with negative results in each case.

A control set of tubes with human albumen (.1 per cent., 1 per cent. and 2 per cent. solution) was introduced in the final complement fixation test, with negative results throughout as far as the .1 and 1 per cent. solutions were concerned, the 2 per cent. solutions sometimes showed a very partial inhibition of haemolysis. Human serum and synovial fluid from the knee joint were used as samples of human albumen. The rabbits stood the injections of the extracts very well and no animals were lost in the course of immunisation.

Technique of the Test.

The samples of nasal discharge sent for the test were examined microscopically and culturally (no full identification of the organisms being attempted except in a few instances) and grouped according to the classification previously given.

Each sample was suspended in 5 per cent. solution of antiformin, shaken up and extracted in the incubator over night. The amount of antiformin added was approximately five times the initial volume of the sample. A comparative investigation of the samples extracted with 2, 5, 10, 20 per cent. solutions of antiformin showed that whereas the 2 per cent. samples were not efficient enough, the 10 and 20 per cent. samples did not give as marked results as the 5 per cent. samples. As regards the time of extraction it cannot be much prolonged in case of 5 per cent. solutions without impairing the antigenic efficiency of the extract.

In the commencement of this investigation the extracts obtained were filtered through paper and through a Berkefeld filter, but it was found ultimately that the filtration through Berkefeld apparently reduced the antigenic activity of the extracts, and the filtration through paper only was resorted to.

Preliminary control experiments have shown that a 1 in 10 dilution of the 5 per cent. solution of antiformin *per se* did not interfere with the action of complement on a mixture of the red corpuscles of the sheep and amboceptor; nor had it any hæmolytic effect on the red cells.

The actual technique of the reaction consisted in testing the absorption of an excess of complement by mixtures containing a uniform dose of 1/10 dilution of the extract with varying doses of the "immune" rabbits' serum and vice versa.

The hæmolytic system used for determining the absorption of complement consisted in a 5 per cent. suspension of sheep corpuscles to which a five times minimum hæmolytic dose of "amboceptor" had been added.

Table I. gives the protocol for the titration of the amboceptor.
Table II. gives the scheme for the titration of complement.
Table III. gives the scheme of the actual test.

TABLE I.—*Minimum hæmolytic dose was found = ·00066.
5 times M.H.D. = ·0033 or ·1 cc. of a 1/10 solution.*

Hæmolytic serum.	Complement 50 per cent.	Sheep corpuscles 5 per cent. suspension.	Saline.	Amount of amboceptor.	Results after 45 min. at 37° C.
Final dilution.					
1/10 ·1 200 ...	·05	·5	1·35	·01	Complete hæmolysis.
1/15 ·1 300 ...	·05	·5	1·35	·0066	" "
1/20 ·1 400 ...	·05	·5	1·35	·005	" "
1/30 ·1 600 ...	·05	·5	1·35	·0033	" "
1/35 ·1 700 ...	·05	·5	1·35	·00286	" "
1/40 ·1 800 ...	·05	·5	1·35	·0025	" "
1/45 ·1 900 ...	·05	·5	1·35	·0022	" "
1/50 ·1 1000 ...	·05	·5	1·35	·002	" "
1/55 ·1 1100 ...	·05	·5	1·35	·0018	" "
1/60 ·1 1200 ...	·05	·5	1·35	·00166	" "
1/65 ·1 1300 ...	·05	·5	1·35	·00158	" "
1/70 ·1 1400 ...	·05	·5	1·35	·00143	" "
1/75 ·1 1500 ...	·05	·5	1·35	·00133	" "
1/80 ·1 1600 ...	·05	·5	1·35	·00125	" "
1/85 ·1 1700 ...	·05	·5	1·35	·0017	" "
1/90 ·1 1800 ...	·05	·5	1·35	·00111	" "
1/95 ·1 1900 ...	·05	·5	1·35	·00105	" "
1/100 ·1 2000 ...	·05	·5	1·35	·001	" "
1/110 ·1 2200 ...	·05	·5	1·35	·0009	" "
1/120 ·1 2400 ...	·05	·5	1·35	·0008	" "
1/150 ·1 3000 ...	·05	·5	1·35	·00066	" "
1/200 ·1 4000 ...	·05	·5	1·35	·0005	Partial hæmolysis.
Control 1/10 ·1 ...	·05	·5	1·35	0	No hæmolysis.
Complement control.	·05	·5	1·35	0	" "
"Blood" control	0	·5	1·35	0	" "

TABLE II.—*Minimum hæmolytic dose = ·02 of undiluted complement.*

Undiluted complement.	Sensitized corpuscles 5 per cent. suspension.	Saline.	Results after 30 min at 37° C.
·005	·5	1·495	Partial hæmolysis.
·01	·5	1·49	Nearly complete hæmolysis
·02	·5	1·48	Complete hæmolysis.
·03	·5	1·47	" "
·04	·5	1·46	" "
·05	·5	1·45	" "
·06	·5	1·44	" "
·07	·5	1·43	" "
·08	·5	1·42	" "
·09	·5	1·41	" "
·1	·5	1·4	" "
·12	·5	1·38	" "
·15	·5	1·25	" "
—	·5	1·5	No hæmolysis.

The complement was always added in corresponding amounts of a 50 per cent. dilution.

TABLE III.—*Scheme of the actual test and results summarised.*

No.	Antiformin extract of discharge.	Undiluted in- activated serum.	Com- plement 50 per cent.	Hæmo- lytic system.	Saline.	Results after 45 min. at 37° C., corrected the next morning.
1	1/5 .1	.2	Four	.6	q. s. to	Invariably no hæmolysis.
2	1/10 .1	.2	minimum	.6	make up	"
3	1/20 .1	.2	hæmolytic doses.	.6	to 2 cc. of total volume.	Traces of partial" hæmo- lysis in the majority of cases. I.
4	1/5 .1	.1	"	.6	"	As above. II.
5	1/10 .1	.1	"	.6	"	
6	1/20 .1	.1	"	.6	"	
7	1/5 .1	.05	"	.6	"	Invariably no hæmolysis.
8	1/10 .1	.05	"	.6	"	Partial or traces of hæmolysis.
9	1/20 .1	.05	"	.6	"	Partial or traces of hæmolysis. III.
10	1/5 .1	.1 1/10	"	.6	"	Invariably no hæmolysis.
11	1/10 .1	.1 1/10	"	.6	"	Partial or traces of hæmolysis.
12	1/20 .1	.1 1/10	"	.6	"	Partial or complete hæmolysis. IV.
13	1/5 .1	.1 1/50	"	.6	"	A few samples of sera
14	1/10 .1	.1 1/50	"	.6	"	gave results similar to
15	1/20 .1	.1 1/50	"	.6	"	No. IV.
16	1/5 .1	No serum	"	.6	"	Complete hæmolysis.
17	1/10 .1	"	"	.6	"	" "
18	1/20 .1	"	"	.6	"	" "
19	No antigen	.2	"	.6	"	" "
20	"	.1	"	.6	"	" "
21	"	.05	"	.6	"	" "
22	"	No serum	"	.6	"	" "
23	1/200 Human albumen.	.1 .2	"	.6	"	Invariably complete hæmolysis.
24	1/110 Human albumen.	.1 .2	"	.6	"	Invariably complete hæmolysis.
25	1/50 Human albumen.	1 .2	"	.6	"	Sometimes traces of or partial hæmolysis.

Controls as usual and a control with a normal rabbits' serum
All negative in each case.

The last Table (III.) must be supplemented in two ways.

Firstly, each *new sample* of serum was tested in addition to the above against several series of multiples of the minimum hæmolytic doses of the complement, *i.e.*, it was sought to determine the highest dose of complement which was completely fixed in the presence of the minimum active doses of the diagnostic serum. Should, *e.g.*, a given sample of serum react positively in dilutions 1/5, 1/10, 1/20 but not 1/30 the dilution of 1/20 was tested afresh in the following way :—

TABLE IV.

No.	Antigen.	Serum 1:20.	Complement. 50 per cent.	Hæmolytic system.	Saline.	Results.
1	1/10 ·1...	·1	4 M.H.D.	·6	q. s. to make	No hæmolysis.
2	1/10 ·1...	·1	10 M.H.D.	·6	up to 2 cc.	No hæmolytic;
3	1/10 ·1...	·1	15 M.H.D.	·6	of total volume in each tube.	traces of hæmolytic; partial hæmolytic.
4	1/10 ·1...	·1	25 M.H.D.	·6		Partial hæmolytic.
5	1/10 ·1...	·1	35 M.H.D.	·6		Nearly complete or complete.

Secondly, should a sample of nasal discharge give a positive reaction in a dilution 1/20 (see Table III.) in the presence of *diluted* serum (e.g., ·1 cc of a 1/10 dilution) the extract of the sample was further diluted in order to determine the lowest limit at which it still reacted.

Table V. is the reproduction of the protocoll of such an experiment.

TABLE V.—*The lowest limit of the antigenic properties of a sample of nasal discharge.*

28/10/13.	Sample 25/10/13, Islington.	"Grey Serum" 50 per cent.	Complement 50 per cent.	Hæmolytic system and saline.	Results.
1	1/10 ·1 ...	·2	·05 (=4 M.H.D.).	As usual	No hæmolysis.
2	1/20 ·1 ...	·2	"	"	" "
3	1/30 ·1 ...	·2	"	"	" "
4	1/40 ·1 ...	·2	"	"	" "
5	1/50 ·1 ...	·2	"	"	Traces of hæmolysis.
6	1/60 ·1 ...	·2	"	"	" "
7	1/80 ·1 ...	·2	"	"	" "
8	1/90 ·1 ...	·2	"	"	" "
9	1/1000 ·1 ...	·2	"	"	" "
10	1/10 sample control.	No serum	"	"	Complete hæmolysis.
11	Serum control	·2	"	"	" "
12	Blood control	No serum	No compl.	"	No hæmolytic.

The lowest limit in this instance was reached when the extract was diluted 1/40 but even in as high a dilution as 1 100 there were only *traces of hæmolysis* observed in the test.

Results obtained.

I have tested :—

153 samples of nasal discharge from cases of scarlet fever.

45 samples of mucous discharge from cases of diphtheria.

5 samples of ear discharge from cases of whooping cough.

2 samples of knee joint fluid from cases of acute arthritis.

40 samples of nasal discharge from cases of simple rhinitis.

The samples of nasal discharge from cases of scarlet fever may be divided into two groups :—

(a) Nasal discharge collected into sterile vessels directly (80 samples).

(b) Nasal swabs (73 samples).

The difficulty connected with the collection of a large number of samples of nasal discharge directly into vessels was a very great one and consequently I decided to test whether nasal swabs could be used equally well for the reaction.

The swabs were detached from the wire and simply dropped into a sterile test tube containing 2 cc. of a 5 per cent. solution of antiformin. The tubes were sealed up and shaken for half an hour and then incubated over night. The extracts obtained were diluted in a proportion 1 to 10 (*see above*) by means of saline without any previous filtration.

As a control I used diphtheria swabs, which were treated in an exactly similar manner.

1. From the 80 samples of nasal discharge collected as such ("direct" samples) 60 gave a positive result. 81.2 per cent. positive results.
2. From the 73 samples of nasal swabs ("swab" samples) 38 gave a positive result. 52.5 per cent. positive results.
3. From the 45 samples of diphtheria swabs six gave a positive result. 13.3 per cent. positive results.
4. From the three samples of ear discharge (whooping cough) none reacted positively.
5. From the two samples of knee joint (arthritis) none reacted positively.
6. From the 40 samples of nasal discharge (simple rhinitis) three reacted positively.

Analysis of Results.

From the consideration of the above results it follows that the "swab method" is much less satisfactory. Twelve samples were examined comparatively, *i.e.*, a swab was taken from the nose and a sample of nasal discharge "as such" was collected from the same patient. From the duplicate samples, ten of the "direct" samples gave a positive test as compared with seven of the "swab" samples.

If a sufficient quantity of the discharge was collected on the swab ("swab soaked" with the discharge) there was practically no difference between the two methods of collecting.

It is clear, therefore, that the results obtained with the "direct" samples are alone reliable enough for the purposes of an analysis.

The 80 "direct samples" which gave a positive test belonged to the three groups of the classification, *i.e.*, they were "very pure," "pure," and "contaminated."

Of the 15 negative samples, nine were of the "contaminated" group and six of the "pure." It seems, therefore, that the more contaminated the samples, the less the percentage of positive results.

As far as the stage of the disease is concerned, the majority of the samples were obtained from cases of scarlet fever with chronic nasal discharge.

In four cases the test, which was positive several times on the same patient, became and remained negative, in spite of the fact that the discharge persisted.

In several cases a throat swab, a nasal swab, an ear swab and a "direct" sample from the same patient were examined comparatively with entirely negative results as regards the ear and the throat swabs.

Conclusions.

This investigation cannot be regarded as finally concluded as additional experimental data should be obtained in testing samples of nasal discharge from cases of other acute fevers such as measles, and also in testing samples of the mucus from the throat and nose on a more extensive scale.

The results so far obtained, however, seem to indicate—

- (1) That it is possible to immunise rabbits against antiformin extracts of nasal discharge from cases of scarlet fever.
- (2) That the "immune serum" obtained may be applied for the complement fixation test in scarlet fever.
- (3) That samples of nasal discharge, as such, extracted by means of a 5 per cent. solution of antiformin tested with the above "immune serum" gave a positive complement fixation reaction in a large percentage of cases.
- (4) That extracts of "nasal swabs" give less satisfactory results.
- (5) That it would be desirable to follow up such cases of scarlet fever, in which the test ceased to be positive in spite of the persistence of chronic rhinitis, in order to determine whether the patient may be regarded under such conditions as free from infection.

My thanks are due to Professor R. T. Hewlett in whose Department this work has been carried out.

I am very greatly indebted to J. Biernacki, M.D., Medical Superintendent of the Plaistow Fever Hospital, for the great interest he has taken in this work and the very valuable assistance he has given me. Also to Dr. D. MacIntyre, of the Plaistow Hospital, for the trouble he has taken in supplying material.

I am grateful to William Hunter, M.D., Senior Physician to the London Fever Hospital, for the facilities he has given me and also to Dr. R. P. Garrow for the material placed at my disposal.

REFERENCES.

1. LATEINER, HECHT AND WILENKO :—Ueber Komplementbindungs reaction bei Scharlach. Wiener Klinische Wochenschrift. 1908, No. 15.
2. HÄNDEL AND SCHULTZ :—Beitrag zur Frage der Komplement ablenkenden Wirkung d. sera v. Scharlachkranken. Zeitschrift für Immunitätsforschung. Orig. Vol. I, p. 91. 1908.
3. UFFENHEIMER :—Ueber Komplementbindung bei Scharlach Münchenen Mediz. Wochensch. 1909. No. 48. p. 2471.
4. BARANNIKOFF, J. A. :—Die Reaktion von Bordet Gengou beim Scharlach. Russky Wratch. 1911. No. 19. p. 833.
5. KOESSLER, K. K., AND KOESSLER, J. M. :—Specific Antibodies in Scarlet Fever. Journ. of Infectious Dis. 1911. Vol. IX., p. 366.
6. ISABOLINSKY AND LEGEIKO :—Centralblatt für Bakteriologie. Or. Vol. 71, p. 521. 1913.
7. VOLPINO, G. AND CLER, E. :—Die Untersuchung des Wassers auf Typhusbacillen mit d. Komplementbindungs Verfahren. Cblatt. Bakteriologie. Or. Vol. 58, p. 392. 1911.
- 7a. RÖSLER, K. :—Ueber d. Nachweis d. Typhusbacillen im Wasser mittels Kompl. ablenkung. Cblatt Bakter. Or. Vol. 61, p. 166. 1912.

- 7b. VOLPINO AND CLER :—Ueber d. Aufsuchen d. Typhusbacillen im Wasser nach dem Kompt. b. Verf. Cblatt Bakter. Or. Vol. 62, p. 422. 1912.
8. NEDRIGAILOFF, W. :—Ueber d. Anwendung d. Kompt. bind. Methode für Untersuchung von Cholera faeces. Zeitschrift für Immunitätsforschung. Or. Vol. III, p. 338. 1909.
- 8a. AMAKO, T., AND KOJIMA, K. :—Kompl. bindung bei Cholera u. d. Wert der Komp. b. reaktion mit d. Fæces für die rasche Serologische Choleradiagnose. Zeitschrift f. Chemotherapie, Vol. 1, p. 2. 1912.
9. BERNHARDT, G. :—Experim. Untersuchungen ueber die Scharlachätiologie. Deutsche Mediz. Woch. 1911. p. 791.
10. LANDSTEINER, LEVADITI AND PRASEK :—Téntatives de transmission de la Scarlatine au Chimpanzé. Comptes Rend. Société de Biologie, Vol. 70, p. 641; also C. R. Academie de Sciences, Vol. 152, p. 1190.
11. LANDSTEINER, LEVADITI AND PRASEK :—Essais de transmission de la Scarlatine aux singes. Annales de l'Inst. Pasteur, Vol. 25, p. 754.
12. LANDSTEINER, LEVADITI AND DANULESCO :—Contribution à l'étude de la Scarlatine experimentale. C. R. Société de Biologie, Vol. 72, p. 388.
13. CANTACUZÈNE, J. :—Inoculation de la Scarlatine aux singes inférieures. C. R. Société de Biologie, Vol. 71, pp. 196, 198, 281, 283; see also Vol. 70, pp. 403, 406.
14. DRAPER, G., AND HANFORD, J. M. :—Experiments on the transmission of Scarlet Fever to the lower monkeys. Journ. of Exper. Medicine. Vol. 17/5, p. 517.
15. Compare NUTTALL :—Blood immunity, &c. Cambridge University Press.
16. ALTMANN, R., AND SCHULTZ, J. H. :—Verwendung v. Bakterien Antiformin-extrakten als Antigene bei der Komplementbindung. Zeitschrift für Immunitätsforschung, Vol. III, p. 98. 1909.
- 16a. UHLENHUTH, P. :—Centralblatt für Bakteriöl. Referate, Vol. 42 (Supplement). p. 62; also Centralblatt für Bakteriöl. Referate, Vol. 50 (Supplement). p. 177.
- 16b. TSUZUKI :—Ueber die Schnellimmunesierung nach Fernet and Müller—Zugleich eine Antiformin Nachprüfung. Zeitschrift für Immunitätsforschung. Vol. IV., p. 194. 1909.

APPENDIX B., No. 3.

FURTHER NOTES on the ADVANTAGES of PRESERVING GLYCERINATED CALF LYMPH in COLD STORAGE at a TEMPERATURE BELOW the FREEZING POINT; by Dr. F. R. BLAXALL.

Since the original papers* on the advantages of preserving Glycerinated Lymph at temperatures below the freezing point were published, this method has attracted considerable notice amongst those interested in the question of vaccination, and some mode of cold storage has been, or is being, adopted in most large Vaccine Institutions.

Recently Professor L. Voigt, of Hamburg,† strongly advocated its employment before the congress held in Vienna of the directors of the Vaccine Institutes of Germany, and for some time refrigerating plants have been installed in France and elsewhere.

There appears to be a considerable number of refrigerating systems in use and some diversity of opinion as to their relative merits. In some instances it seems as if institutions were relying on rather small installations which appear prone to get out of order, or at best can with difficulty be maintained at a steady temperature.

I have been asked so many times for details and plans of our installation, that perhaps fuller particulars than those previously given‡ may be of interest.

The cold store is situated on the north side of the building and is sunk below the level of the ground for about one-third of its height.

It is a square brick building with a flat asphalted roof. The interior is divided into three compartments. (1) the engine room and ice-making plant, (2) an air-lock, 4 feet by 4 feet by 7 feet high, leading from engine room into (3) the cold chamber, 12 feet by 8 feet by 8 feet high. Air-lock and chamber are thoroughly insulated for 9 inches with match-boarding and slag wool.

The refrigerating apparatus consists of a carbonic acid gas compression engine, having a 2-inch compressor and a 9-inch stroke. It is belt driven by $7\frac{1}{2}$ -h.p. motor, actuated by direct current. A water cooler on the roof of the main building serves to cool the compressed C.O.². The total brine capacity is about 250 gallons. The cold chamber is fitted with six drums suspended from the roof and two 2 inch coils on two side walls. For the storage of the lymph rack shelving is provided in the cold chamber. The prepared lymph is placed first in glass tubes hermetically sealed, these tubes are packed inside earthenware jars tied over with parchment, and the earthenware jars are placed in japanned iron boxes with stout lids. These boxes are placed on the shelves so that in the event of a leak from a brine drum overhead, or flood below, the lymph would be effectually protected.

* Blaxall and Fremlin. Reports of Medical Officer of the Local Government Board, 1906-7, 1908-9, Appendix C.

† Voigt. Hygienische Rundschau, 1913. No. 21.

‡ Brief Description. Report of Medical Officer of the Local Government Board, 1910-11, Appendix C.

In the corner of the cold chamber is a cupboard, 4 feet by 2 feet by 5 feet high, well insulated, with a tight fitting door. It is cooled by two brine drums and a large coil of 2-inch piping separately derived from the engine. This cupboard has great advantages, in it various low temperatures can be obtained, -15°C . if required, moreover the cupboard serves as an alternative store for lymph when any repairs are needed in the cold chamber, or when the drums are cleared of snow, &c., which periodically requires to be done.

In the engine-room is an ice-plant which is worked separately from the engine, and alternately with the cold chamber.

In our early use of the cold store and in the initial experiments, I used a temperature of -6.5°C . or 14° of frost Fahrenheit; but I found a lower temperature of -11°C . or 20° of frost Fahrenheit gave better results, and have since adhered to that temperature. To maintain this, the engine is worked for about an average of six hours a day throughout the year, in two shifts of three hours each, longer in the hot weather, less in the cold.

The temperature of the cold chamber is taken morning and evening, the average morning temperature being -10.8°C . and the average afternoon temperature -11.3°C ., with a mean of -11°C .

In a previous paper* an account was given of the results obtained with lymph stored at a temperature of -8°C . to -10°C . for two years. This experiment was repeated in the new cold store, the lymph being stored for two years at a temperature of -10°C . to -11°C . For this purpose nine series taken at random, were, immediately after glycerination, placed in the cold store. The lymph was placed in small test tubes carefully corked, and packed in a tin box, the lid of which was hermetically sealed with solder. At the end of two years the box was withdrawn from the cold store and the contents examined.

The nine series were issued for public vaccination 16 to 65 days after the expiration of the two years, being replaced in the cold store until issued. Table I. shows the results of their use.

TABLE I.—*Results of Lymph kept in Cold Store two years.*

Series.	No. of Persons Vaccinated.	Percentage Success.	
		Casc.	Insertion.
1	788	99.2	96.7
2	1,164	99.7	96.4
3	1,013	99.6	97.1
4	932	99.7	97.4
5	1,316	99.4	96.4
6	743	99.3	95.4
7	902	100	97.8
8	1,337	99.5	95.3
9	814	99.9	98.2
Total	9,069	99.6	96.7

* Blaxall and Fremlin. Report on further results of storage of Glycerinated Calf Lymph at a temperature below the freezing point. Report of Medical Officer of the Local Government Board, 1908-9, Appendix C.

These results fully confirmed the previous observations and demonstrated clearly that storage at these temperatures completely preserved the potency of Glycerinated Calf Lymph.

Since 1908 all lymph issued for public vaccination from this Establishment, has, for a longer or shorter period, been preserved in cold store with very satisfactory results. Table II. shows the results of the use of the lymph annually from 1908 to 1913.

TABLE II.

Year.	Primary Cases.			Re-vaccinations.		
	Cases.	Percentage Success.		Cases.	Percentage Success.	
		Case.	Insertion.		Case.	Insertion.
1908	433,615	99·4	95·9	13,725	98·1	95·0
1909	408,964	99·4	96·0	16,537	97·8	94·8
1910	379,599	99·3	95·6	12,871	93·0	94·5
1911	354,170	99·4	96·0	25,349	96·7	93·1
1912	334,347	99·4	96·0	12,000	97·7	94·5
1913	307,005	99·4	96·0	12,566	97·3	93·0

The uniformity of the results shown in this table is noteworthy ; it will be seen that as regards primary cases the case and insertion success from year to year is practically identical.

Further illustration of the length of time which lymph can be stored at these temperatures, is given in the following.

From March, 1911, to September, 1913, 230 lymphs were issued which had been kept in cold store 12 months and over before being issued. The results of these lymphs are given in Table III. and included in Table II.

TABLE III.

Lymphs.	Number of Persons used for.	Percentage Success.	
		Case.	Insertion.
230—aged 12 months or over.	247,767	99·3	95·7

The average age of these lymphs at date of issue was 19 months.

Of the 230 lymphs 51 were aged at date of issue 24 months and over, the oldest being 27 months.

The results of the use of these 51 lymphs are given in Table IV.

TABLE IV.

Lymphs.	Number of Persons used for.	Percentage Success.	
		Case.	Insertion.
5!—aged 24 months or over.	53,128	99·4	96·2

It is evident again here that the lymph had lost nothing in potency even by prolonged keeping; no doubt the period of storage could be considerably increased without appreciable impairment, but for all practical purposes two years appears to be sufficiently long.

Some doubt has been raised* that cold store lymph may deteriorate, as regards potency, more quickly when removed from the cold store than it otherwise would have done if not subjected to the influence of the lower temperature. That has not been my experience.

There is no question but that glycerinated lymph, or indeed, lymph preserved in salt solution or plain water, rapidly commences to deteriorate in potency if exposed to heat, that is to say, to temperatures above the freezing point, though the cooler the temperature the slower and less appreciable will be the degeneration, and hence glycerinated lymph removed from cold store and subjected to the influence of outside temperatures, especially in hot weather, will like glycerinated lymph that has not been in cold storage, gradually be impaired by the action of the heat. But in my experience, this impairment and eventual destruction takes place no more quickly in the case of cold store lymph than in the case of ordinary lymph. On the contrary, there is some reason to think that the cold store lymph has an enhanced resistance.

It is most important to remember in the study of lymph, that at all stages after the collection from the calf, exposure to heat, that is to temperatures above the freezing point, is inimical to the potency of the lymph, and therefore lymph should be transferred to the cold store as soon as possible after collection if the best results are desired. To preserve the potency most completely I believe the best plan to be to triturate the lymph with the proper proportion of glycerine and water immediately after collection from the calf and to transfer to cold store the same day. But in practice I place the freshly triturated lymph at $+15^{\circ}\text{C}$. for one week to assist in the elimination of the extraneous germs and then transfer to cold store at -11°C . As the results given in Table I. show, this exposure to heat for one week does not appreciably diminish the potency as judged in the aggregate, but, though the more robust lymphs show no noticeable impairment, a more definite falling off may sometimes be observed in those lymphs, which were noted, at the time of collection, as being somewhat weak, and this I attribute in large measure to the small exposure to heat, namely, one week at 15°C ., that they have undergone.

In Professor Voigt's report, I notice that some of the lymphs with which he deals in regard to this question, were kept from one to two

* Voigt. Hygienische Rundschau, *ibid*.

months after collection before they were placed in cold store, and this suggests to me that these lymphs were already somewhat weakened before being subjected to the cold, and would therefore almost certainly show a rapid decrease of potency when removed from the cold store and exposed to the higher temperature.

It follows from the foregoing that in all stages in the preparation and use of glycerinated calf lymph the greatest care is required to keep it from exposure to heat, and it is very desirable that this point should be impressed on all who have the handling of lymph, for even when removed from the Institutes' cold store and distributed to others for use or sale, much may be done by urging the employment of domestic ice chests, vacuum flasks, &c. in order to assist in the preservation of the lymph after issue. Nothing can be more prejudicial to the potency of glycerinated lymph than that it should be left lying about exposed to the injurious effects of room temperature or worse.

We have endeavoured to meet this point by sending out with all lymph issued for public vaccination the following instructions:—

1. That the lymph is to be kept in the cool and in the dark.
2. That lymph is not to be used when it has been in the possession of the recipient longer than a week.

These instructions are given not because the lymph necessarily would become seriously weakened after more than a week at outside temperature, but in order that lymph may, as far as possible, be regarded as material which needs to be carefully preserved and safeguarded against adverse conditions. It has always to be remembered that in lymph we are dealing, not with a stable chemical agent, but with a living organism, and one very prone to become inactivated if placed in unsuitable conditions, and these instructions have for their object, to impress the recipient with the need for care in the preservation of the lymph. In our experience, they have in this respect been extremely valuable. However, the second instruction is not always rigidly adhered to, for many vaccinators have found that by attention to, and application of the first instruction, the potency may be retained considerably over a week by taking every care of the lymph and keeping it in an ice chest or domestic refrigerator.

It is important to bear these points in mind, because there is no doubt that cold stored lymph (or other glycerinated lymph) if exposed to fire heat or sun heat, or too much light, will speedily become inactivated.

If cold stored lymph deteriorated rapidly after removal from the cold and on exposure to ordinary temperature, we should certainly expect that this deterioration would be more marked in hot weather than in cold.

Heat in England (when it occurs) is limited almost entirely to the third or September quarter of the year, from July 1st to September 30th, and it is in this quarter we should expect to see signs of impairment of potency unless the lymph possessed sufficient resistance to withstand the bad influence of the summer warmth.

In Table V. I give the results of the use of the lymph set out quarterly since 1908, that is from the date when the cold store was fully in use.

TABLE V.

Quarter.	Primary Results.		
	Cases.	Percentage Success.	
		Case.	Insertion.
March, 1908	107,631	99·5	96·4
June, "	117,386	99·4	95·7
September, "	114,842	99·4	95·8
December, "	93,756	99·3	95·9
March, 1909	103,960	99·5	96·2
June, "	113,112	99·5	96·3
September, "	106,365	99·3	95·5
December, "	85,527	99·3	96·0
March, 1910	96,946	99·3	95·7
June, "	104,931	99·2	95·4
September, "	98,854	99·3	95·7
December, "	78,828	99·2	95·6
March, 1911	98,392	99·5	96·5
June, "	92,903	99·4	95·7
September, "	86,009	99·4	96·0
December, "	76,866	99·3	95·8
March, 1912	87,192	99·4	96·4
June, "	90,633	99·4	96·1
September, "	85,972	99·3	95·8
December, "	70,550	99·4	96·0
March, 1913	75,504	99·3	95·8
June, "	86,914	99·4	96·1
September, "	77,973	99·3	95·8
December, "	66,614	99·5	96·6

It is evident from this that there is no appreciable difference in the results obtained at the different seasons.

Before the use of cold storage this was by no means the case, the results of the September quarter were lower than other quarters, and we had frequent complaints in the hot weather of inert lymph.

This point is even more strongly emphasised by an examination of the year 1911. In that year England experienced a very warm summer, the mean temperatures of the months of July, August and September being considerably above the average. Thus in July, on all but seven days, a temperature higher than the normal was recorded. (The normal being the average temperature for the 65 years ending 1905). The excess ranged from 15·1°, July 22nd, to 0·3°, July 16th. (Temperatures in Fahrenheit.) The highest shade temperature recorded was 95·6°, July 22nd. In August, on every day, the average shade temperature was higher than the normal, the excess ranging from 18·5°, August 9th, to 0·1°, August 23rd. The highest shade temperature was 100·0°, August 9th. In September the number of days above the normal was 19, the excess ranging from 15·7°, September 8th, to 0·2°, September 24th. The highest shade temperature was 94·1°, September 8th.

Yet in this exceptionally hot quarter the results of the use of the lymph were practically the same as in the other quarters of the year, as shown in the preceding Table.

The whole of the lymph used in this year was lymph which had been kept in cold storage. The fact that the unusual heat of the

September quarter brought about no impairment of the lymph used in that quarter is attributable entirely, I think, to the use of cold-stored lymph.

That the storage of lymph in the cold may be a success, several points, I think, need close attention.

1. In all stages in the preparation of lymph, avoid as far as possible any exposure to heat.

2. Store at a temperature as far below the freezing point as practicable, and see that the temperature at that point is regularly maintained, a varying temperature, even below the freezing point, is undesirable.

3. Endeavour to prevent exposure to heat even after the lymph is issued for use.

APPENDIX B., No. 4.

SECOND REPORT on the USE of OIL of CLOVES in the
PREPARATION of GLYCERINATED CALF LYMPH; by
Dr. F. R. BLAXALL.

In the two years that have elapsed since the first report* on this subject was published, oil of cloves has been employed, in the manner mentioned in that paper, as part of the routine in the preparation of lymph.

Its use has given throughout most excellent results, and the opinion expressed in that report as to its value has been amply confirmed.

By its action the extraneous organisms have been most markedly diminished, and in not a single instance has it appeared that the use of clove oil has acted prejudicially on the potency of the lymph.

This method has attracted attention abroad and has been the subject of experiment by Dr. M. Belin of Tourst†, by Professor D. de Blasi of Rome‡ and by M. Antoine of Brussels.§

These investigators all regard the method with favour, and though their modes of experimentation were somewhat different from those suggested by me and not, I think, calculated to be so effective, they each independently confirm my conclusions.

To obtain the best results in the use of clove oil, it is obviously of great importance that the agent should be intimately mixed so that it is in contact with, and thereby able to exert influence on, every particle of the lymph. This is best effected, in my experience, by triturating the lymph with its complement of vehicle (glycerine and water) with which the oil of cloves has already been intimately mixed. In my practice each lymph on the day of its collection, after being weighed and having apportioned to it four times its weight of 50 per cent. glycerine and water containing .1 per cent. oil of cloves, is passed through the triturating machine three times; the first time with but little of this diluent added, the second time with two-thirds of the diluent, and the third time with the whole.

This method gives a chance to the clove oil to come in contact with every particle of the lymph during the process of trituration, and no doubt to this is due the remarkable diminution in the extraneous organisms, to which I alluded in the former paper, which is noticeable directly after the trituration. The result is a homogeneous emulsion, of which all the particles are in a very fine

* Report of Medical Officer of the Local Government Board, 1911-12.

† Belin. De l'épuration du vaccin par l'essence de girofle. *Revue Internationale de la Vaccine*, Juillet-Août, 1913. *Ibid*, *Revue Internationale de la Vaccine*, Janvier-Février, 1914.

‡ De. Blasi. L'épuration du vaccin au moyen de l'essence de girofle. *Revue Internationale de la Vaccine*, Janvier-Février, 1914.

§ Antoine. Purification de la pulpe vaccinale au moyen de l'essence de girofle. *Bulletin de l'Académie Royale de Médecine de Belgique*. IV. Serie, Tome XXVII No. 11.

state of division. As a test of the quality of the emulsion in this respect, each product is carefully examined by the eye, and if the emulsion does not appear quite even, smooth and homogeneous, the whole is again put through the triturating machine. A loopful of the emulsion if suspended in a little distilled water in a watch glass, should practically disappear; no definite particles should be visible to the naked eye. With such an emulsion one knows that both glycerine and clove oil are in such intimate association with the triturated lymph particles, that they have power to exert their influence on the contained extraneous organisms. This emulsion is placed in short test tubes holding approximately 40-50 c.cs. each, and these are carefully and effectually corked. Such an emulsion after a week at 15° C. and a long sojourn in the cold store at - 11° C., perhaps for over two years, as a rule shows no separation of the emulsion into a solid and a fluid part. In a few instances a little separation occurs, sometimes in the middle of the tube, sometimes at the top or bottom. Precisely what conditions determine the site of the separation are not clear to me, but if there should be separation, I have never perceived any free oil in the fluid, if I did I should consider it as a source of danger, because it is essential for the success of the method that there should be no free oil since free oil of cloves may exert its powerful disinfectant action not only on the extraneous organisms but also on the specific vaccine organisms. If this mode of preparation is adopted there is no need for the repeated turning of the tubes which M. Belin suggests. But I quite agree with him that with different treatment, *i.e.*, a less intimate emulsion, separation may occur and free oil be seen on the surface of the fluid, when of course its action on the extraneous organisms is prevented and its presence, instead of being a benefit, becomes a positive danger. Indeed, unless fine trituration of the lymph and intimate association of all the components of the emulsion be carefully aimed at, such separation is only too likely to occur. In that case the only remedy is to retriturate the whole, either in a machine or by pestle and mortar, and achieve a more complete homogeneity. Not till that has been attained can one ensure the full and proper benefits of clove oil.

M. Belin says he regards suspiciously a lymph containing water lest the potency of the lymph should be injuriously affected. I can assure him that after 15 years experience, I have no fear of water in this respect. If water produces autolysis (*i.e.*, action which assists in the disintegration of the cellular particles) and helps in the disintegration of the organic matter of lymph pulp I welcome its action. My aim is to produce as minute a disintegration of the organic matter or cutaneous particles as possible, and that is why I have constantly advocated and practised the finest trituration of the lymph. By this disintegration one is enabled to liberate the specific vaccine organisms and to disseminate them evenly through the emulsion, thus producing a regularity in dosage and in results which otherwise it is difficult to attain. If the employment of water assists in this work, as it may do under certain conditions, its use is desirable. But in the circumstances of its use in this method, so definite is the incorporation of the water with the glycerine in a 50 per cent. solution, that I have some doubt whether any autolytic action it may possess can be appreciated. Such action would be limited entirely, probably, to the one week the emulsion was stored at 15° C., and I have never observed any appreciable autolysis in that time, nor have I observed it to any marked extent in a

50 per cent. glycerine and water emulsion of lymph kept at that temperature for a prolonged time. At times a slight, very slight, increase in the acidity of the emulsion has been noticed, suggesting the breaking down of cells and the evolution of complex bodies, such as nucleinic acid, &c., but careful investigations made at the time led me to the conclusion that this was not associated of itself with loss of potency. Considered in relation to present methods my experience leads me unhesitatingly to assert that the water present has no effect on the potency of the lymph.

In this connection it may be of interest to recall some former work of my colleague, Dr. H. S. Fremlin,* on this subject. He showed that admixture of lymph with different proportions of 50 per cent. glycerine and water, and 80 per cent. glycerine and water, gave results, as regards potency, equally good and indistinguishable one from another, whereas, if M. Belin's hypothesis be correct, admixtures containing 80 per cent. glycerine and water, that is with less water, should have given the better results. In my experience, lymph will retain its potency equally well, whether stored as a suspension in water, in salt solution, or in mixtures of glycerine and water of various proportions, provided—and this is the really important matter—it is not exposed to heat. It must be kept below 10° C., otherwise the potency very rapidly disappears. The lower the temperature the more prolonged is the vitality. If the agency of heat is taken into account, then I agree with M. Belin that autolysis or disintegration, whether by the action of water or by other methods, is a disadvantage, but not of itself, but because, by liberating the specific organisms in the suspension, it causes them to be more accessible to the influence of heat than if they were still embedded in fragments of tissue. Hence the necessity of taking every care that heat shall have no access to any preparation of lymph.

But the action of water on lymph is easily demonstrated. Let some lymph be ground in a mortar with a fair proportion of water, (I generally use 10 or 12 times the weight of water to one part by weight of lymph), allow the mixture to macerate at the temperature of the ice chest + 10° C. At this temperature organisms, especially of the proteus group, will grow abundantly and the disintegration of the organic particles goes on apace. It may be aided by a daily trituration of the lymph and water in a mortar, which accelerates the breaking down of the lymph particles. The extraneous organisms, especially of the group mentioned, will multiply enormously and speedily, the lymph will be reduced to a very fine state of division, but the potency of the lymph is not in the least impaired and its vitality will be maintained for a long time, longer in many instances if kept at a low temperature, than in a glycerinated emulsion of the same lymph. But this is a matter upon which I hope to enlarge with fuller details in a subsequent report. A few trials of this kind will show clearly that it is not water that is prejudicial to the potency of the lymph, but heat.

In the routine use of clove oil in the preparation of lymph, I have adopted a strength of .1 per cent., as recommended in my original paper, and the experiments I have made since with different strengths of Oil of Cloves, have confirmed me in that choice.

* Fremlin. Report of Medical Officer of the Local Government Board, 1902-3. Effect on Vaccine of various proportions of 80 per cent. Glycerine and Water Solution.

Oil of Cloves, .2 per cent. and .3 per cent.

I have made further trial with strengths of .2 per cent. and .3 per cent. The number of the experiments was small and not conclusive, but so far I see no reason to think that these strengths are preferable to that of .1 per cent. The lymphs prepared with .2 per cent. clove oil showed themselves in potency very slightly weaker than the controls; in those prepared with .3 per cent. the difference was a little more marked. As regards the effect on the extraneous organisms the elimination was as marked as in the case of .1 per cent., but hardly appreciably greater. .3 per cent. seemed to be a little more rapid in action but again the difference was not very marked. In this respect the effect of .1 per cent. on the extraneous organisms is so striking that one could hardly expect much contrast to be shown.

Eugenol.

I have also made a few further experiments with eugenol, which on the whole are confirmatory of those previously reported.

It was employed in strengths of .1 per cent. and .25 per cent. The action of the former on the extraneous germs was rather variable, but the latter showed, as before, a marked disinfectant action on the extraneous organisms. It appeared, however, as if at this strength, in some instances the eugenol might have slightly weakened the potency of the lymph.

Lanoline and Clove Oil.

I have made several experiments with lanoline, mixing it with various proportions of clove oil, in order to ascertain whether under these conditions clove oil could exert on lymph its disinfectant properties.

If this were the case, the use of clove oil-lanolinised-lymph might have considerable advantages in India and the tropics, as lanoline at ordinary temperatures is not so hostile to the activity of lymph as glycerine.

Lanoline was melted and various proportions of oil of cloves added up to a strength of 1 per cent.

The prepared lanoline was then mixed with lymph in a mortar, taking four parts by weight of lanoline to one part of lymph. But I found that under these conditions and at these strengths the effect of clove oil was nullified, no special action on the extraneous germs could be observed. Indeed, there was a multiplication of these in some instances as not infrequently happens with lanoline.

Similar results were obtained with other fatty substances with which I have experimented, notably olive oil. It appears as if oil of cloves were unable to exert its disinfectant action on the extraneous germs of lymph in the presence of a considerable amount of fatty body. This seems to me a point of considerable interest, and it may explain why occasionally one finds a lymph in which the disinfectant action of clove oil is not so marked as ordinarily: possibly that particular lymph contains more fatty body than usual, and thereby the effect of the clove oil is diminished.

Cold Storage and Oil of Cloves.

Sufficient time has now elapsed to demonstrate very clearly that these two agents are mutually complementary and beneficial in the

preparation and preservation of lymph. In my previous paper, though I had no apprehensions on the point, I was not then in a position to prove that lymph treated with clove oil would retain its full potency if kept for a long time in cold store. Now, however, we have abundant evidence that clove oil used in the way described and of a strength of .1 per cent. has no effect on the potency of the lymph, which retains its activity when stored in the cold as perfectly as ordinary lymph untreated with oil of cloves. Thus in oil of cloves we have an agent which exerts a rapid and powerful disinfectant action on the extraneous germs, but does not affect the potency of the lymph, and this in combination with storage below the freezing-point permits us to preserve lymph in its full potency, and practically germ-free for almost indefinite periods.

APPENDIX B., No. 5.

SOME EXPERIMENTS to TEST the VALUE of ETHER as an AGENT for the PURIFICATION of VACCINE LYMPH; by Dr. F. R. BLAXALL.

In a paper, read before the International Congress of Medicine in London in the year 1913, and in communications* published September and October, 1913, Dr. W. Fornet advocated the use of ether as a means of purifying lymph from the extraneous organisms whilst leaving its specific vitality unimpaired.

In 1900 I had myself experimented with ether for this purpose without success, and in 1901 my then colleague, Dr. A. B. Green, also investigated its action, as to which he says of ether and some other substances that they† “eliminated the extraneous bacteria . . . in varying degrees of rapidity and all in their higher strengths more quickly than the glycerine of their controls. But also they destroyed the potency of the specific organisms, in some cases in very short periods of time.”

Subsequently, in 1907, I further experimented with the vapour of ether and its action on lymph, but again with no success. Hence I was greatly interested in Dr. Fornet's communication, and at once endeavoured to repeat his experiments.

Fornet's method is to take crude lymph pulp, grind it in a triturator with a very little salt solution, then add ether, 20 ccs. to each gramme of pulp, place in a bottle, carefully seal the mouth and shake energetically for 20 hours, at the expiration of this time the extraneous germs will all have been destroyed, if not, further shaking with ether is resorted to, for he says that the ether is incapable of destroying the specific organisms even if the operation is prolonged for 120 hours or more.

In my experiments I followed this method as closely as possible, with the exception that I did not keep up the continuous shaking, but the etherized lymph during the time of the experiment, was frequently shaken by hand.

Experiment I.

Five grammes of pulp were ground up very finely in a mortar with 5 ccs. of physiological salt solution. The ground-up lymph was then placed in a well-stoppered bottle, and to it was added 100 ccs. of methylated ether, sp. gr. .720. The stopper of the bottle was carefully sealed, and the contents shaken repeatedly during

* Die Reinkultur des Pockenerregers, Dr. W. Fornet. Wiener Naturforscherversammlung, 24th September, 1913.

Die Reinkultur des Pockenerregers, Dr. W. Fornet. Wiener Medizinische Wochenschrift, No. 41, 1913.

Die Reinkultur des Pockenerregers, Dr. W. Fornet. Berliner Klinische Wochenschrift, No. 40, 1913.

La culture pure du Virus Vaccinal, Dr. W. Fornet. Revue Internationale de la Vaccine, September-October, 1913.

† Report of Medical Officer of the Local Government Board, 1900-01, page 651. The Disinfectant action of Chloroform and various other substances, &c., Dr. A. B. Green.

24 hours. At the same time two other grammes of the same pulp were ground up in the same way, and 40 ccs. of salt solution were added, making a strength of 1 in 20. This was to serve as control, and from this plates of nutrient agar were poured in the usual way, as soon as the emulsion was made. At the expiration of 24 hours the bottle containing the etherized lymph was unstoppered, and as much of the ether poured off as possible without losing any lymph: the bottle was then placed in vacuo to remove the remaining ether by evaporation. This being effected, 100 ccs. of physiological salt solution were added and the whole well shaken, the strength now being 1 in 20, similar to the control. Agar plates were poured from this and also from the control. Three rabbits were taken and shaved on the side. Two were inoculated with the etherized lymph, and the third with the control lymph. On each rabbit an area of $1\frac{1}{2}$ inches square was inoculated with $\frac{1}{4}$ cc. of the respective emulsions. On the third and fourth days these rabbits were inspected. The two inoculated with the etherized lymph showed no result whatever, the third, that inoculated with the control, showed beautiful confluent vesicles all over the inoculated area.

Of the plates poured, those inoculated with the etherized lymph were sterile, the control showed a mean of 500 colonies.

Experiment II.

One gramme of fresh lymph pulp was ground up finely in a mortar with 4 ccs. of physiological salt solution, 20 ccs. of methylated ether were added, and the whole well shaken in a tightly-stoppered bottle as before. At the same time 1 gramme of the same pulp was ground up with 20 ccs. of salt solution as a control.

After 18 hours the ether was removed from the etherized lymph by decanting and evaporation. 20 ccs. of salt solution were added to the lymph and well mixed with it, and this emulsion was tested as before by plate culture and on animals. On plates the etherized lymph showed no growth, whilst the control showed a mean of 720 colonies. On two rabbits the etherized lymph gave no result; the control on a third rabbit gave a good confluent patch of vesicles.

These lymphs were also tested on calves. For these tests an area 3 inches square is marked on the calf skin previously shaven; this is lightly scarified and $\frac{1}{2}$ cc. of the subject of the experiment painted on with a sterile camel's hair brush. The results were the same as on rabbits. The etherized lymph on two patches gave no result; the control a confluent vesiculation of the whole area.

Experiment III.

In this experiment 1 gramme of pulp was etherised in the same way, but the ether was only in contact with the lymph for four hours and was then removed. Another gramme of pulp was etherized using only half the amount of ether, that is 10 ccs. of ether and 10 ccs. of salt solution, and the ether was evaporated at the end of four hours. A salt solution control to these lymphs was made at the same time.

Agar plates were poured as soon as the ether had been removed and animals inoculated, that is in $5\frac{1}{2}$ hours from the commencement of etherization,

RESULTS.

—	Plates at 5½ hours.	Calves.	Rabbits.
	Colonies.		
Etherized lymph	0	Nil.	Nil.
Lymph 1: ether 20, for four hours, re-diluted with salt solution, 1 in 20.	0		
Etherized lymph	0	42 small vesicles	7 small vesicles
Lymph 1: ether 10, salt solu- tion 10, for four hours, re-diluted with salt solution, 1 in 20.	0		
Control	68,400		
Lymph 1, salt solution 20.	77,400	Confluent ...	Confluent.

Thus, according to these experiments, ether had completely destroyed the potency of the lymph exposed to its influence for 24 hours, 18 hours and 4 hours, and in 4 hours at half strength had very materially weakened it.

These results were in such disagreement with Forner's that I thought they might be due to the ether not being sufficiently removed, though if Forner's dictum is correct, that ether is incapable of destroying the specific organisms even if action is prolonged for 120 hours or more, retention of a little ether ought not to make any difference. In future experiments, however, I thought it advisable to take more pains in the dissipation of the ether and to satisfy myself that it was entirely removed.

Experiment IV.

One gramme of lymph was etherized as before and left in contact with ether for 19 hours. After standing a little, the supernatant ether was decanted and a current of sterile air blown over the surface of the lymph for two hours, until, in fact, no odour of ether could be detected. The lymph was then almost dry. To this was added 20 ccs. salt solution and the whole well shaken, when the odour of ether was again perceptible. A current of air was again blown over it for one hour until no odour of ether could be appreciated. To compensate for the loss of salt solution by evaporation during this operation, the emulsion was made up to 20 ccs with salt solution and tested as before.

Another gramme of lymph was etherized for five hours and treated in the same way.

—	Plates at 19 hours.	Plates at 23 hours.	Rabbits.
	Colonies.	Colonies.	
Etherized lymph	1	3	8 small vesicles.
Lymph 1: ether 20, 19 hours, re-diluted with salt solution, 1 in 20.	2	7	
Etherized lymph	0	0	Semi-confluent, very small vesicles.
Lymph 1: ether 20, 5 hours, re-diluted with salt solution, 1 in 20.	9	6	
Control	7,200	—	
Lymph 1: salt solution 20.	6,800		Confluent, good vesicles.

This experiment was repeated, the same care being taken to remove all the ether. The results were very similar and are given in Experiment V.

Experiment V.

—	Plates.	Rabbits.
Etherized lymph Lymph 1: ether 20, 19 hours, re-diluted with salt solution 1 in 20.	Colonies. 11 0	(1) 4 small vesicles. (2) 15 small vesicles.
Etherized lymph Lymph 1: ether 20, 5 hours, re-diluted with salt solution 1 in 20.	23 2	(1) semi-confluent, about 32 small vesicles. (2) 9 small vesicles.
Control Lymph 1: salt solution 20.	1,360 1,008	Confluent, good vesicles.

These experiments seemed to indicate that complete removal of the ether had had a beneficial effect. Possibly the passage of a strong current of air over the lymph for a considerable time had had a revivifying effect as though bringing about a recovery from an anæsthetic.

At this stage it struck me that the methylated ether I had been using might not be the same as employed by Fornet. Nowhere, as far as I can find, does he particularize as to the kind of ether he used. I therefore resolved to try other ethers, and for this purpose I took sulphuric ether sp. gr. .720, ethyl ether (made from rectified spirits) sp. gr. .720, and the same methylated ether as before.

Experiment VI.

One gramme of pulp was etherized with each of these ethers in similar fashion to those of the preceding experiments, and at the end of 19 hours the ether was removed by passage of a current of sterile air. In this instance 10 ccs. only of salt solution were added to each lymph after removal of the ether, making a strength of 1 in 10, that is, twice that of previous experiments.

	Plates at 19 hours.	Calves.
A.—Methylated ether Lymph 1: ether 20, re-diluted with salt solution, 1 in 10.	1 0	Small vesicles but nearly confluent.
B.—Sulphuric ether Lymph 1: ether 20, re-diluted with salt solution, 1 in 10.	1 23*	Small vesicles semi- confluent.
C.—Rectified ether Lymph 1: ether 20, re-diluted with salt solution, 1 in 10.	1 1	Nil.
D.—Control Lymph 1: salt solution 20.	1,800 1,450	Confluent, good vesicles.

* Possibly an error.

This experiment was repeated, the lymphs being left in contact with the various ethers for 20 hours. When the removal of the ethers was effected the lymphs were re-diluted, 1 in 20 with salt solution. Results are given in Experiment VII.

Experiment VII.

	Plates at 20 hours.	Calves.
A.—Methylated ether	1	32 very small vesicles.
Lymph 1 : ether 20, re-diluted with salt solution, 1 in 20.	1	
B.—Sulphuric ether	0	Nil.
Lymph 1 : ether 20, re-diluted with salt solution, 1 in 20.	1	
C.—Rectified ether	0	Nil.
Lymph 1 : ether 20, re-diluted with salt solution, 1 in 20.	0	
D.—Control	4,188	Confluent, good vesicles.
Lymph 1 : salt solution 20.	4,410	

These experiments are of interest, because they show that ethers derived from different sources and by different processes have different properties. It appears that ethyl ether prepared from rectified spirit is more potent than methylated ether, and sulphuric ether is intermediate. It may be that Fornet has used an ether less potent than the methylated ether I have employed throughout these experiments, and this may account for my inability to obtain similar results to those recorded by him.

One other experiment remains to be noted. A lymph was very finely ground up and emulsified with salt solution to a strength of 1 in 50. From this nearly all the organic matter, cellular debris and albumen, was removed, leaving a nearly clear fluid which was found to be quite potent.

To 5 ccs. of this fluid was added twice the volume of methylated ether, and the two shaken together frequently for six hours. The ether was then blown off, and the remaining fluid tested. Its potency was found to be entirely destroyed giving no result on a rabbit, whereas the same fluid, unetherized, gave on another rabbit at the same time, confluent vesicles.

These experiments lead me to think, that if ether of the kinds I have used comes in direct contact with the vaccine organism, it is killed, and that, in a short time.

When ether is added to lymph ground up with a little salt solution, a coagulum is formed which is very difficult to break up. It is probable that this coagulum serves to protect organisms entangled in its interior by preventing the direct access of the ether. In all my experiments the lymph was very finely ground up in a mortar, and this, by minimizing the size of the resultant particles, would facilitate the penetration of the ether. If not so finely ground up, it is conceivable that ether might have much more difficulty in coming in contact with the organisms entangled in the interior of these particles, and, therefore more of the organisms, in some cases a considerable number, might escape the direct action of the ether and

survive. This is borne out in my experiments by the behaviour of the ether towards the extraneous organisms. Where a positive though much attenuated result as regards potency, was obtained, some of the extraneous organisms, as a rule, also survived, whereas when all the extraneous organisms were killed, as a rule the potency was also nil. Again, from experiment II., it would appear that the amount of ether used has a considerable influence on the action; half the quantity of ether allowing some survival of the specific organism. This I take to be due to an insufficiency of ether to penetrate the whole mass.

It is noteworthy in this connection, that ethyl ether from rectified spirit appears to form a less dense coagulum than methylated ether.

I think there can be little doubt that it is possible by this method of etherization to kill all the extraneous germs and leave some of the specific organisms still alive, though at an immense sacrifice of the potency of the lymph. In my experiments where a positive result as regards potency was obtained, the resulting vesicles were very small and obviously much enfeebled. But success in this matter involves hitting that exact time at which all the extraneous organisms have succumbed, and before the destroying influence has overwhelmed all the specific organisms.

Ether in this respect acts like nearly all other disinfectants, the extraneous organisms are affected first, and if at that moment the influence of the ether or other disinfectant can be removed, the specific organism may survive, but in the case of ether there appears to me to be such a very small "margin of safety" in point of time between the lethal point of one and the other, that I do not think this method of etherization is to be commended as of practical value in the preparation of lymph.
